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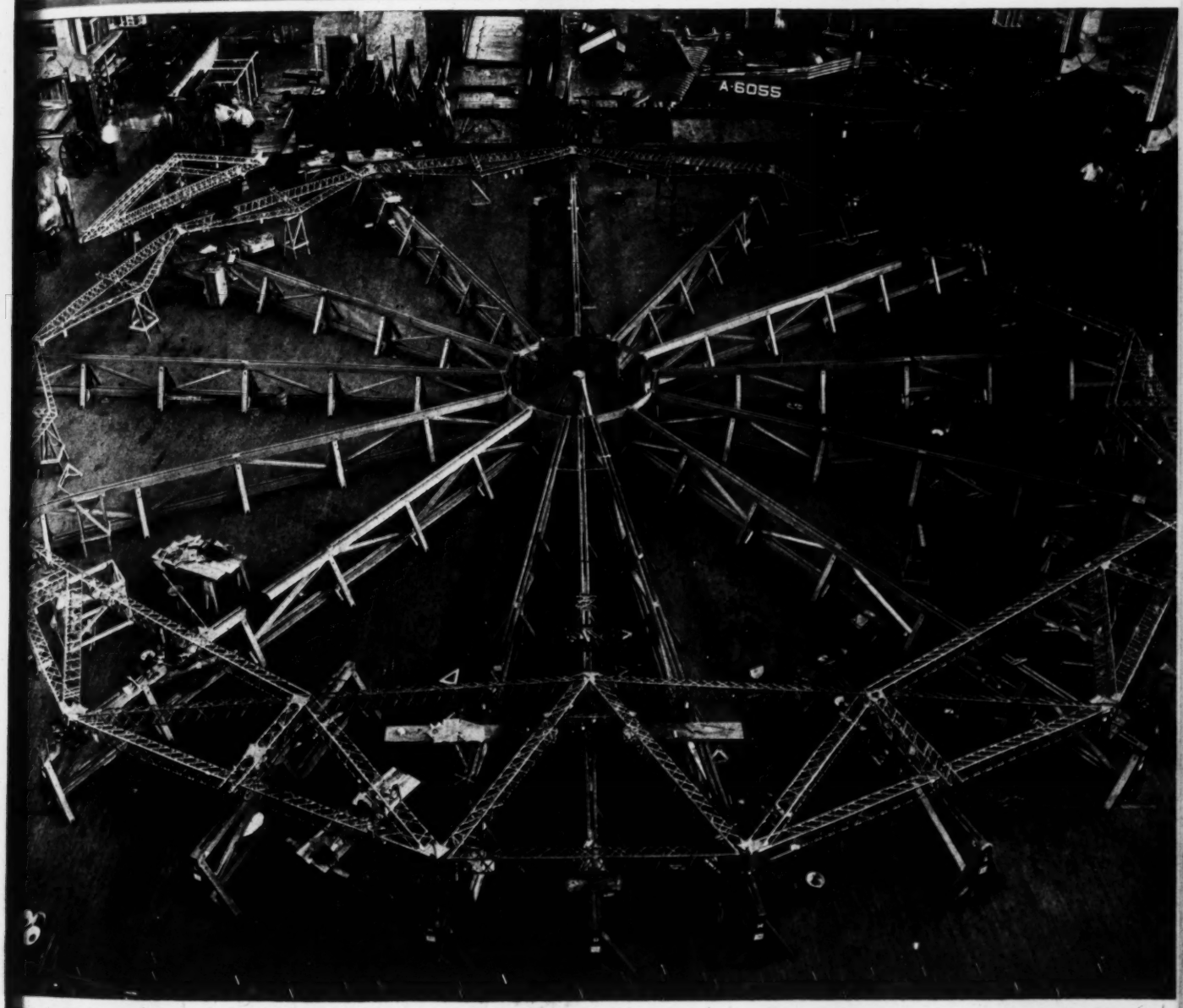


New Gravity Freight Yard at Denison, Texas

Extensive Layout on Cutoff Line Has Capacity for 80 Trains and for Classifying 2,000 Cars

Building the Navy Airship ZR1

Structural Engineering in Dirigible Airship Work Develops New Knowledge and Processes—Strength of Riveted Duralumin Members Determined by Test

Six pages of Job and Office Hints

Highway Progress and Problems in the Mid-South—III

Kentucky and Tennessee. An Editorial Review Based on Studies in the Field

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. McGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

Volume 91 — NEW YORK, AUGUST 9, 1923 — Number 6

A Man Departs

HE CAME to power when the world was out of joint; his was the heavy task of setting it right. Small wonder that he was not able in the brief two years allotted him to build up the broken body. The healing of the economic and political wounds made by a great war is a long process and doctors and specifics can do little to hasten it. His was the temperament which put its trust in calm and order, which distrusts the unusual and loves accord. There are those who would have had more of the iron hand in his velvet glove, a more spectacular and emphatic program for relief, but who can say which of the two courses will lead to the most speedy cure? One thing remains; a man has gone, a lovable personality, a personification of the American ideal of rise from obscurity to the great place of the nation. To all of us, from those scattered settlers in our far northern outposts who last saw him in his prime, to the busy workers in our crowded cities who were shocked by the headlines last Friday morning, there will remain the inspiration of his kindly spirit. And this is Warren Harding's greatest legacy to the people he was chosen to lead.

A Prophecy?

IT WAS at the reconstruction congress of governors and mayors called by President Wilson in March of 1919. There was a rather crowded buffet luncheon served that day in the large state dining room of the White House, where only standing room was available except for a few chairs ranged against the walls. In one of these, the great, high-backed, eagle mounted mahogany quite evidently reserved for the President's use at the head of his own table, sat a man clad in the severest of black relieved only by the white of linen—a curiously pallid face intensified by his smooth, plastered taffy colored hair. An unnatural seriousness seemed to overburden him. So strange he looked that one of the editors of this journal who was there was moved to ask who he was. "Why," was the answer, "that's Coolidge of Massachusetts."

New Structural Possibilities

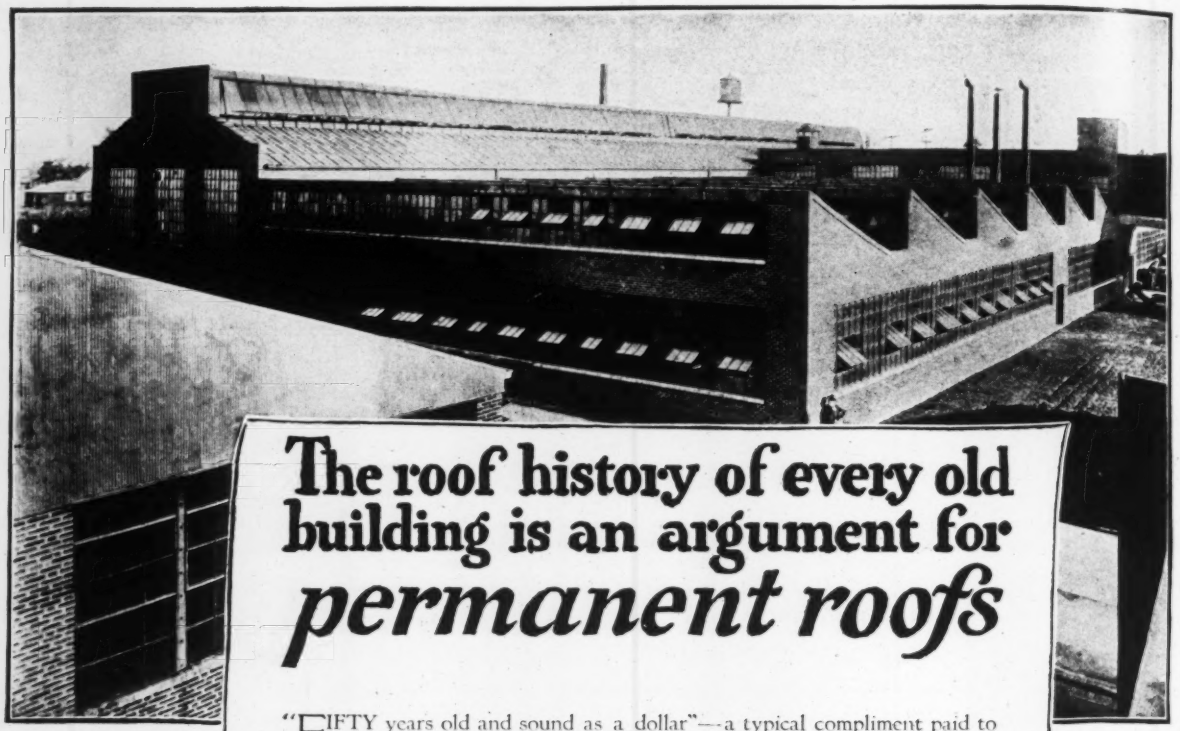
TO THE ENGINEER familiar with steel construction the use of material of sheet-metal thickness in large engineering structures necessarily appears so far outside the range of practical possibility as to be wholly out of relation to his engineering thinking. The rust danger makes it imperative to use thick sections, and in consequence the entire habit of structural practice and structural thinking is predicated on thick material. The engineer is likely to carry his conclusions farther, however, to the extent of believing structural framing of thin material to be impracticable from the standpoint of strength and all but impossible from the fabricating standpoint. In the airship just completed at Lakehurst we have convincing proof that such conclusions are wrong, and correspondingly the work is of remarkable instructional and stimulative value. The successful solution of all fabricating difficulties shows clearly that shop requirements do not fix a lower limit of thickness. And on the question of strength, several hundred tests of members of the airship, showing very high strengths in column, beam, and combined service, have established the fact that this sheet-metal structural work can be developed to substantially as high a strength efficiency as we expect in ordinary structural steel members. The Navy Department is entitled to the thanks of the structural engineering profession for making available an account of its construction experiences, and it is to be hoped that the test results also will be placed before the profession soon. The building of the ZR1, as described in some of its technical aspects in this issue, is certain to exert a strong, progressive influence on the development of thought in the structural field.

The Port of San Francisco

WITH the recent adjournment of the California legislature, the fight to prevent taking control of the San Francisco waterfront away from the state and giving it to the city has again been won. The case for the state is so clear that it will bear study. Two navigable streams empty into San Francisco Bay, and together drain a valley 500 miles long with 10,000,000 acres of fertile land of which about 5,000,000 is now under irrigation. These rivers, therefore, serve a useful transportation purpose in delivering produce to a central market or shipping point. Under these conditions a port becomes something in which many shippers have a vital interest and in whose management and control they are entitled to have some influence. Under state management the facilities provided on San Francisco's waterfront for the distribution and export of produce have encouraged the development of farms and factories in the great central valley. Without such facilities the products of those farms and factories could not be profitably marketed. Should control of the port be transferred from the state to a small part of the area from which the traffic of the port is drawn, the remainder of the area would have to take chances on getting necessary concessions.

State Harbor Control

ON ONE point San Francisco has ground for dissatisfaction with the present arrangement. The east bay cities are not under the jurisdiction of the State Board of Harbor Commissioners, and they are therefore in a position to compete as they please for the business of the port. San Francisco, being unable to dictate waterfront policies, rates, etc., as do the cities across the bay, feels itself to be the victim of discrimination. Although a large percentage of the



The roof history of every old building is an argument for *permanent roofs*

"FIFTY years old and sound as a dollar"—a typical compliment paid to an old structural landmark that still champions the architecture of 1870.

But—how many times during those years has the roof been patched and replaced, how many hundreds of dollars have been dumped into roof maintenance?

Each one of these old structures has taught the construction world the extravagance of putting short-lived roofs on otherwise permanent buildings.

The Rockwood Manufacturing Company of Indianapolis like hundreds of other prominent concerns has accepted this lesson. They built for permanence and, unlike some less enlightened concerns, they did not stop at the roof. Large quantities of Federal Interlocking and Channel Tile were used and as this and hundreds of other Federal installations are proving, their roof maintenance problem is eliminated.

The recognized permanence of concrete, [the only structural material that improves with age] the established excellence of the Federal product, and the fact that it is laid and guaranteed by the manufacturer—these were the considerations that led the Rockwood Company to specify—

made for flat and pitched surfaces

FEDERAL Cement Tile

"The Roof for Permanence"

Made, Laid and Guaranteed by

FEDERAL CEMENT TILE CO., 110 S. Dearborn St., Chicago

Works: Hammond, Indiana and Detroit, Michigan

business of the port as a whole is still handled on the San Francisco side of the bay, east bay cities have grown rapidly and it is highly important that some way be found to prevent rivalry between bay cities that is not in the best interests of the port as a whole. Rather than to vest full port control in the city of San Francisco the state jurisdiction should be extended to all the bay cities with some proportional representation and some measure of local veto which would prevent unfair domination by state interests not connected at all with the port. This has been done by interstate control at New York, though as yet the results have been disappointingly small, it has existed for years at Boston, it doubtless will eventually be brought about at Philadelphia. There is no similarity between the usual demand for home rule of cities and the demand which San Francisco and New York make for release from state authority in their ports. Property interests, through their sinister representatives, the real estate men, seem to assume that possession of some waterfront land gives autocratic rights to a harbor. That is wrong in principle; the port is merely a gateway for the state and the country and its administration can not be hampered by the selfish claims of those who happen to live at the gate.

Promotion and Ethics

NOW that the Trenton plans for sewage treatment by the direct-oxidation process have again and finally been rejected by the New Jersey State Board of Health, attention may be turned from the process itself to some ethical aspects of the promotion methods employed in an attempt to hasten action by the board. These are of direct concern not merely to other state health departments but also and more deeply to engineers, since the promoters, besides charging the entire New Jersey board with holding up the plans, laid the onus on one of the two engineer-members of the board and were backed in this by Col. George A. Johnson, consulting sewage-works engineer for Trenton.

The charges submitted to Governor Silzer by Mr. Hirst last February, Mr. Potts' denial, and a summary of what was brought out at the hearing have been detailed in previous issues of this journal. As modified and explained at the hearing, the charges come down to this: Because the Trenton plans had been before the New Jersey Board of Health for two months without final action, and because Mr. Hirst had heard indirectly that Mr. Potts had expressed himself as against approving the plans, and since Mr. Hirst could explain all this to his own satisfaction in no other way than that Mr. Potts was out for "revenge" because he had been denied an interest in the direct-oxidation process, Mr. Hirst decided "to throw the full light of publicity" on Mr. Potts and so brought the charges in question. Colonel Johnson initialed each paragraph of the charges except those alleging motive, but he did not appear at the hearing to substantiate his joining in the charges. Nor did Mr. Hirst offer any testimony whatever to establish his allegation that the other ten members of the board had been induced to join Mr. Potts in holding up the plans, nor that it is at all unusual for a state health department to defer action on sewage-works plans for two months.

This is promotion run mad. It is all the worse because it was seconded by a consulting engineer in a way that seems to have been shrewdly designed more to evade possible punishment under the law of libel than with that high regard for professional ethics that should accompany technical ability. Trying to discredit engineers and to bully and defy state health departments who are skeptical or seem unduly slow in approving plans is hardly the way to establish the direct-oxidation method of sewage treatment, which, like hundreds of others that have been promoted in the last half century, will have to take its place on merit or fall by the wayside.

Traffic on Bridge Approaches

MOTOR traffic has set up entirely new capacity standards for streets and bridges. It is obvious that the greater loads from the heavy motor trucks entail new considerations of load bearing capacity from those held in the days of horse-drawn vehicles, but it is not always remembered that the much greater number of vehicles and their higher speed, both due to the introduction of the motor, have brought with them new problems of space and volume capacity. There is much yet to be done in traffic analysis with relation to roadway width, particularly in the spacing and speed of vehicles for the maximum capacity of a given thoroughfare.

Bridge approaches offer an excellent illustration of this new development. In planning the new vehicular bridges for Portland, Ore., for instance, special attention is being given approaches in the belief that by providing a traffic capacity on approaches greater than that heretofore considered necessary, the result will be a considerable increase in the rate at which the structure as a whole can handle traffic. This point of view is summarized in a comment on Portland's existing bridges (built before motor traffic had become heavy) by the engineers in charge of the new structures that "There is not a single bridge in Portland today that is being used to as much as one-half of its capacity on account of the fact that the approaches in all cases are inadequate to get the traffic on or off the structures."

In planning the new structures effort is being directed toward developing the full capacity of the bridge by approaches of suitable design. The theory on which this is being done is that at the last cross-street the bridge traffic is slowed up, and in fact during the rush hours is frequently brought to a full stop, by the cross-traffic. The bridge traffic therefore is assumed to be entering the bridge approach from a standing start or at a relatively low speed and, according to the ability of the cars to accelerate, will require some considerable distance to attain the speed that gives the maximum capacity on the bridge. If several hundred feet is required to attain that speed, then the approach must be wider than the bridge for that distance in order that the capacity of the approach, on which the average speed of the cars is less, may equal the capacity of the bridge itself, over which the maximum capacity speed is maintained. On the new Burnside bridge five lanes of traffic each way on the approaches are to be converged to three lines on the bridge proper by marking the converging limits of the traffic lanes on the roadway.

In making their bridge capacity studies the Portland engineers disagree with the conclusions reached by Herbert S. Swan and published in *Engineering News-Record*, Feb. 22, 1923, to the effect that a speed of 10 miles per hour, because of the greater spacing required

at higher speeds, gives the maximum capacity, i.e., the maximum number of cars past a given point in a given time. The Portland engineers believe that a higher speed (something like 20 miles per hour) and a closer spacing are safe. The theory in support of this is that it is impossible for any car to come to a full stop instantly and that assuming the greater rate of deceleration in the car ahead (which is the more dangerous situation) the safe spacing would be determined by the relative rate of deceleration of the two cars plus a distance to allow time for the driver of the car behind to get warning that the car ahead is slowing down.

The whole problem is so involved with the human equation and with such widely varying conditions that no mathematical formula can give an exact solution. Moreover, any theoretical solution must be checked with actual conditions in traffic because it is not so much what spacing and speed is best as it is what spacing and speed can be secured, all things considered. Even when theory and practice are co-ordinated it may be that more efficient brakes — such as the four-wheel brakes that are rapidly coming into vogue—or some other factor may require complete revision of the conclusions. It is safe to say, however, that where busy intersections cross bridge approaches, a roadway width greater than that of the bridge proper is justified, and finally that there is need for more study and observation on this whole question of maximum capacity of roadways for motor traffic.

To The New President

IN ACCORDANCE with precedent President Coolidge has announced his intention to carry out in full the policies of his predecessor. There is no doubt of the honesty of this intention but history has shown that each of our Presidents who succeeded in like fashion has before long been forced by the strength of his own convictions and by the force of his own personality into policies of his own, which quite possibly may be in opposition to those which he inherited. Engineers and contractors who have watched as professional and business men and not as partisans the course of the Harding administration, could they obtain the ear of Mr. Coolidge, might well point out some definite viewpoints as to past and future performances which might be of value to the new President.

In the first place there would be praise for the fiscal policy of the Harding administration. In these days of foreign and domestic complications too little credit has been given for the planning at Washington which has led to that combination of increasing income and decreasing outgo which is the primary requirement for either business or government. The excellent administration of the Treasury, which has so successfully taken care of the early stages of the retirement of the war bonds, the successful adjustment of the British debt, the initiation and execution of the beginnings of the federal budget, the veto of the soldiers' bonus with the terrific added burden of expense which was thereby prevented, and the reduction in costly armament (itself possibly the minor part of that crowning diplomatic triumph, the Washington conference, the Far-Eastern agreement and the four-power treaty)—all go to make up a consistently economical fiscal plan for which the administration deserves more praise than has usually been given. Add to this the sane attitude toward business, best exemplified in the methods of the engineer member of the cabinet, and we have a purposeful policy carried out, insofar as it has gone, to the benefit of the country. Few engineers will be found who would advise the President to depart from the course laid out in these matters.

There are, however, two acts, or series of acts, of the Harding administration which in the mind of the engineering profession have been manifestly improper. To what degree the late President approved or condoned them we do not know. We do know, though, that a new chief executive, however much he may feel bound to his late chief, will do well to consider their inherent justice as well as their effect on his political fortunes. We refer to the violent campaign carried on by Attorney General Daugherty against the engineers and contractors of the army construction program and to the reorganization—and possibly disorganization—of the Reclamation Service begun by Secretary of the Interior Work by the dismissal of Director Arthur P. Davis.

Both of these performances smell too strong of party politics. The whole history of the Construction Division suits and indictments, from the strictly partisan Congressional investigation to the personnel of the staff which is using that investigation as its bible, brand that persecution with political motives. It was plainly an effort to magnify the new administration by discrediting the Wilson administration. Reputable engineers and contractors were to be made martyrs in the process. A new and independent study of these cases by the President should be made. He is the one who will now suffer if they are pursued to their apparently inevitably unsuccessful conclusion.

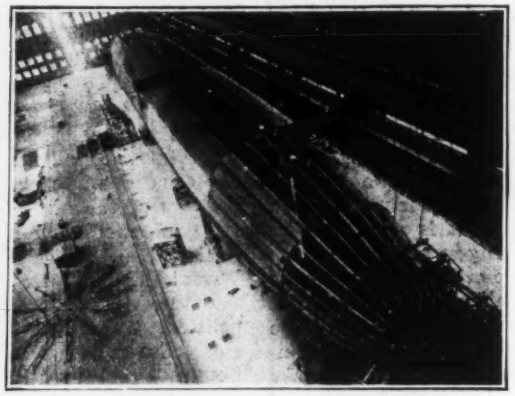
The Reclamation Service case is too fresh in the minds of engineers to need description. Suffice it to say that the evidence is accumulating that Secretary Work was governed more by the necessity for providing a place for one who is politically powerful in certain sections of the West where votes are needed than in an honest effort to put reclamation on a sound basis. Governor Davis, the new commissioner of reclamation, has a business past which is anything but a recommendation if the avowed "business administration" is the main thing being sought in the Reclamation Bureau, but he has been twice elected governor of Idaho and is wise in political methods. The trip to Alaska and the tragedy at San Francisco will delay for a while the combined efforts of the engineers of the country to defend the engineering control of irrigation but nevertheless the evidence in the case is being accumulated and when Congress comes to meet in November, the Secretary will find that he has opened up a controversy which is far wider in its implications than perhaps even he realized. Here again the new President is free to take his own course and to refuse to be burdened by the unwisdom of his predecessors.

Engineers have no desire to form a professional soviet which thinks and acts only for the good of the profession. They are, however, by virtue of their vocation closely concerned with public activities and vitally interested in public policies. We believe, furthermore, that engineering is essentially an unselfish profession, perhaps too unselfish for its own good, but certainly one that is looking toward benefiting the general run of the people all the time. For that reason the views of engineers on such public questions as these are, we submit, worthy of consideration.

Structural Engineering in Dirigible Airship Work:

Building the Navy Airship ZR1

Completion of Ship Marks Solution of Complex Problems of Structural Design, Related to Those Worked Out in Development of Bridge and Building Work



Strength of Riveted Duralumin Members Determined by Tests and Problems of Fabrication and Assembly Worked Out by Trial in the Shop—Elaborate Test Work

FIG. 1—ZR1 APPROACHING COMPLETION

IN UNDERTAKING to build its first rigid airship, the ZR1, the U. S. Navy Department confronted a complex mass of new problems. The completion of the ship, now ready for its trial flights, marks the successful solution of these problems. They are essentially problems of structural design and fabrication, and are closely related to those which have been worked out by gradual practical development in the related field of steel structural work for building and bridge construction.

The ZR1 is a huge structural framework of latticed struts braced by wire ties. Though precisely similar to any structural steel frame in its principles of arrangement, it is made radically different from such a frame by three characteristics: (1) The metal is duralumin, a light alloy of aluminum and copper; (2) the material is in sheet metal thicknesses; (3) the members, with few exceptions, are of triangular cross-section, so that the joints become special problems involving great complication.

The pecularities of the duralumin, the problems of fabricating and assembling the sheet metal members, and the difficulties presented by the joints and of connections constituted the outstanding elements of the fabrication problem.

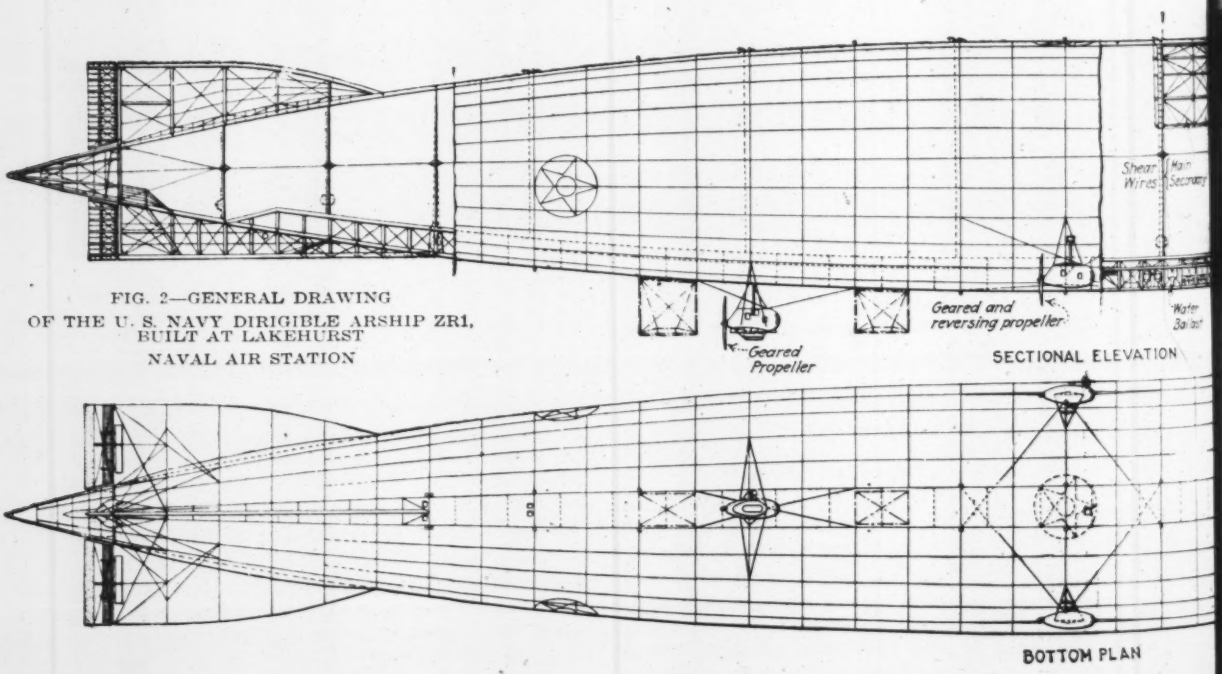
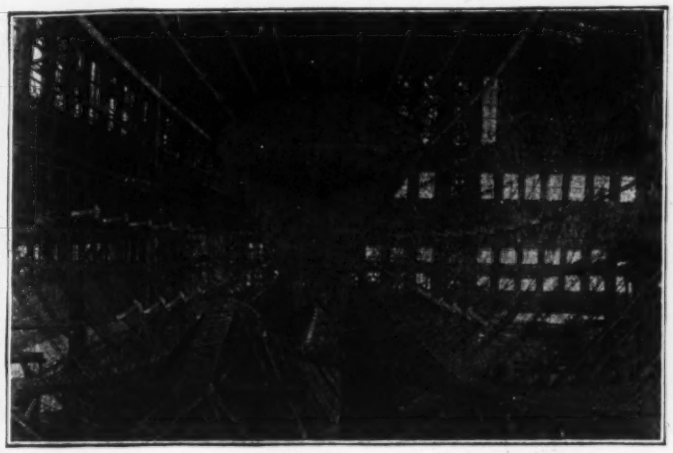
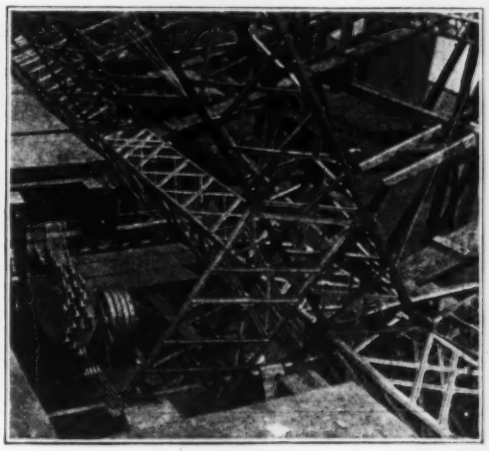


FIG. 2—GENERAL DRAWING OF THE U. S. NAVY DIRIGIBLE ARSHIP ZR1, BUILT AT LAKEHURST NAVAL AIR STATION

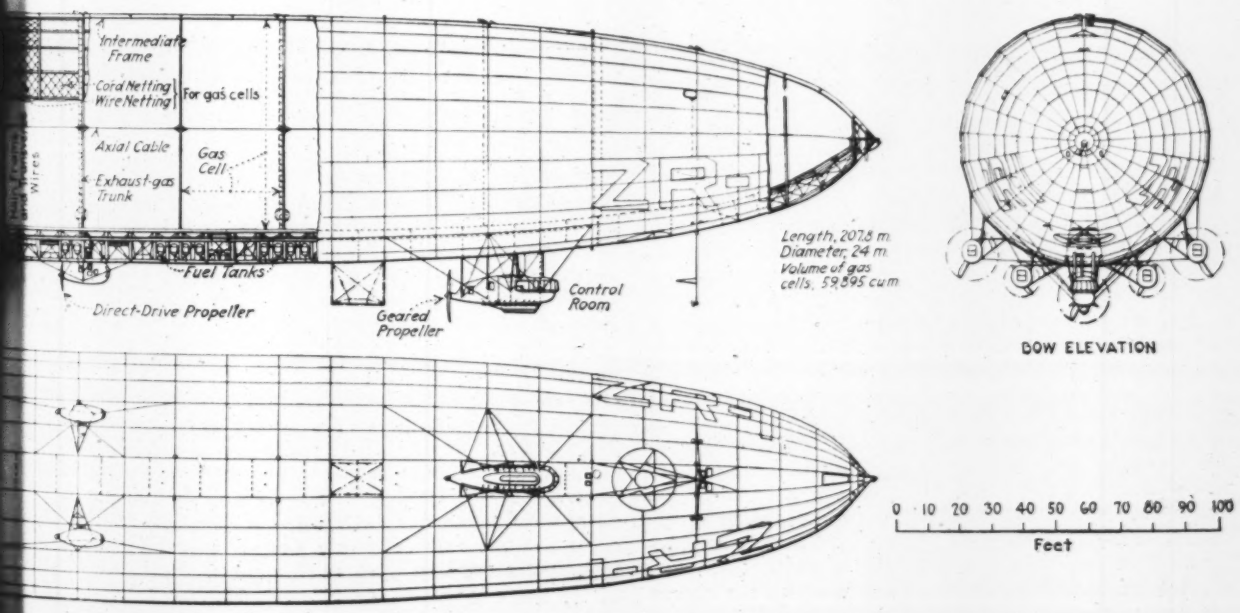
Design presented equal complications and difficulties, in view of the commanding importance of weight economy and on the other hand the absence of precise data for estimation of attacking forces and analysis of the resisting strength of the frame. This part of the development, however, may be summarized for present purposes by the statement that the design is modeled closely after the most successful foreign practice but that many members and parts were increased in strength. Careful analyses of the stresses in the frame for the estimated loads, wind pressures and accelerations were made by two methods of approximate solution of the complex indeterminate framework, which two methods represent opposite divergences from the true condition and thus yield opposite limiting values of the frame stresses. An independent reinvestigation of the design was made last year by an engineering board appointed by the department, composed of men outside the Navy Department. The detailed findings of this board have not been made public, but they are known to include a complete endorsement of the design as safe and adequate.

Structure and Material—For a general understanding of the construction problem it is necessary to outline a few essential facts concerning the structure of the ship and the material used. The frame of the ship, a cigar-shaped body of circular cross-section, 680 ft. long and 79 ft. (24 m.) in diameter in the mid-section, is made up of frame rings spaced 32.8 ft. apart, connected by thirteen longitudinals and made rigid by diagonal wire bracing in the transverse planes of the frames and in the rectangular panels formed by frame members and longitudinals. Halfway between the main frames are intermediate frames, of lighter section and without transverse wire bracing; similarly, halfway between the main longitudinals are intermediate longitudinals, this

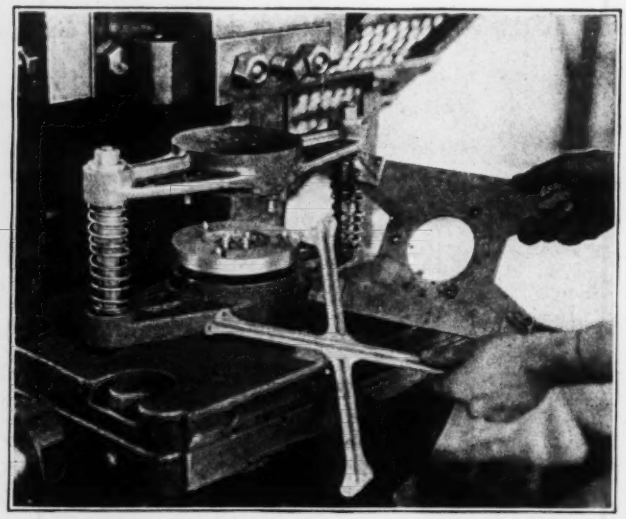


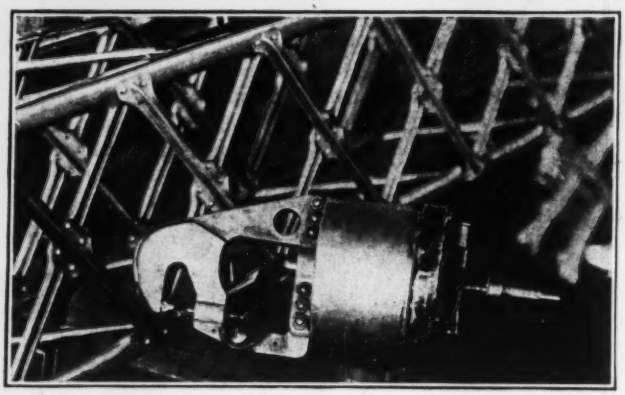


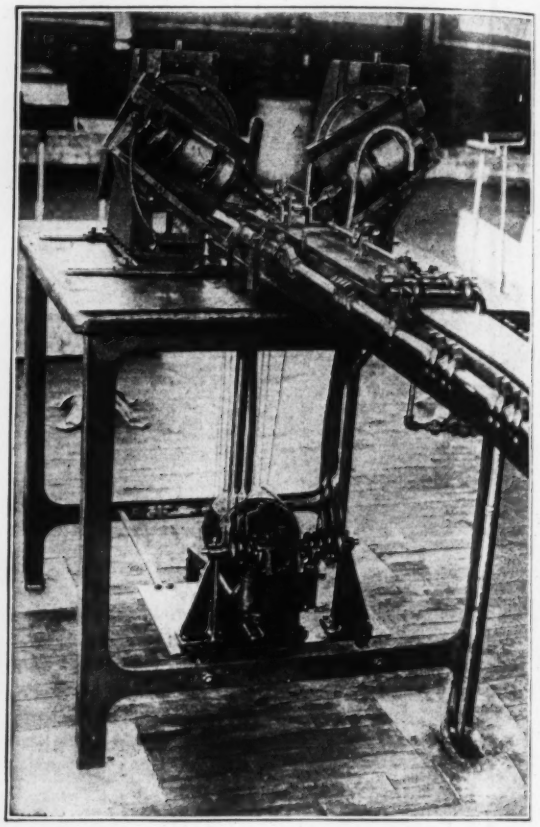
FIGS. 3 AND 4—DURALUMIN FRAMEWORK AND AN INTERIOR JOINT OF THE FRAME



secondary system being braced by a system of secondary wire diagonals in the outer surface. The entire hull frame weighs only about 15 tons; as there are about 3,000 struts in the frame, this is less than 10 lb. weight per average strut. Duralumin, the material used, has a specific gravity of 2.8 (slightly more than one-third that of steel), an ultimate strength of about 55,000 lb. per square inch and a minimum yield point of about 35,000. The frame members are essentially struts or columns, and stiffness against buckling required that







SPECIAL TOOLS FOR DRILLING AND RIVETING STRUTS
Fig. 5 (Top left)—Fixture for riveting lattice cross. Fig. 6 (Right)—Automatic spacing table for drilling strut channels. Fig. 7 (Bottom left)—Compressed-air riveter; grip adjusted by changing dies.

they be of large transverse dimensions and hence of very small metal thickness. For weight economy they were made of triangular cross-section.

Metallurgical difficulties in the production, rolling and handling of duralumin have been largely overcome. The metal may be annealed to a soft state by heating for one-half to one hour at 350 deg. C., and either quenching or slow cooling; or it may be brought to a tempered condition by heating to 490 deg. C. and cooling. Immediately after the tempering treatment it is soft, and remains so for one or two hours, slowly assuming the hard condition. The hard condition is wanted in the finished structural members, but work must be done in the soft condition. The processes of manufacture must therefore be arranged to utilize the short-time soft state immediately following the tempering treatment, unless tempering of the finished article is practicable.

Aside from the difficulties introduced by the nature of the material, there were perplexing difficulties of fabrication, chiefly due to the very light thicknesses of the shapes used. These may be readily appreciated by comparing with ordinary structural steel. As in any structural framework, it was vital that the individual members should be straight and that the structure should be assembled firmly and true to form, with bracing of uniform tension.

Fabrication of the latticed struts was the first and principal problem.

Fabrication of Struts—Duralumin rolled channels of special section for the main members of the struts, and stamped and punched lattice bars were furnished from the mill of the Aluminum Co. of America. The channels were in random lengths, to be cut to length at the factory as required. The lattice bars, cut and formed by die stamping from an annealed rolled strip and punched for the end and center connection rivets, were received ready for assembly.

Fabrication of the parts of the airship was allocated to the League Island Navy Yard, Philadelphia, and erection of the airship to the newly built naval air station at Lakehurst, N. J., where an airship shed 264 x 803 ft. was built three years ago for constructing and housing dirigible balloons (see *Engineering News-Record*, May 6, 1920, p. 892). The work was put in charge of Commander R. D. Weyerbacher, U. S. N., who organized the fabrication at League Island and later took up the erection work at Lakehurst. In both parts of the work it was necessary to develop methods, tools and machines from the ground up, and work out in

succession the problems met in the work. In spite of the assistance of English and German airship experts, the work remained essentially a pioneer undertaking.

Assembling Lattice Bars—For quicker and more accurate assembly of the struts the lattice bars were first riveted together in pairs to form crosses. The necessary high precision was obtained by use of a two-piece fixture shown in Fig. 5. A rectangular plate with corner dowels receives the two lattice bars and positions them; when it is laid over a die plate having three dowels registering with holes in the rectangular plate, the four central rivet holes are brought directly over rivet dies on the die plate, and all four rivets are headed up in one stroke of the press in which the die plate is mounted. The punching of the lattice bars is initially checked up by their fit on the dowels of the frame plate; absence of distortion in the course of the riveting is checked by noting the absence of binding when the riveted cross is removed from and replaced on the plate.

Drilling the Channels—The channels which form the longitudinal members of the struts are first cut to length by hand hack saws, allowing 2-in. over-run at each end. The rivet holes are then drilled in an automatic spacing machine (Fig. 6).

The triangular struts, which form the entire framework except for a few rectangular struts in minor positions, are of two shapes, equilateral and isosceles, the latter having a long side equal to twice the short side. Two forms of channel were provided, differing in the angle between the flanges. Both sections are 1.18 in. wide on the back and 0.459 in. wide on the flange, with the outer edge of the flange slightly turned in to stiffen it; they are 0.59 in. deep. Their thickness ranges from 0.031 to 0.079 in. The angle between flanges is 60 deg. for the channels used in the equilateral sections and the base channels of the isosceles section, and about 45 deg. for the channel used at the peak of the isosceles struts.

In foreign practice, the struts have been built up complete in box-like forms, in which the channels and lattice bars were held firmly in position and then drilled and riveted in place. The builders of the ZR1 decided upon pre-fabrication as being more rapid and accurate, believing that precision in locating the rivet holes would assure straightness and truth of the struts. Laying out and individual drilling of the holes were out of the question from this standpoint, and the development of an automatic mechanical spacing machine was undertaken, with entire success. This is the machine shown in Fig. 6.

One end of the channel to be drilled is attached to a light carriage pulled along the table of this machine by a weight. Dogs along the sides of the table bring

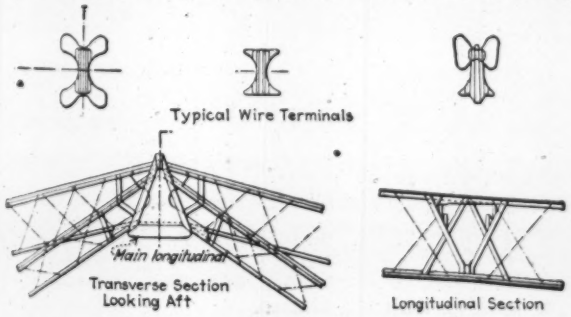


FIG. 8—A TYPICAL FRAME JOINT

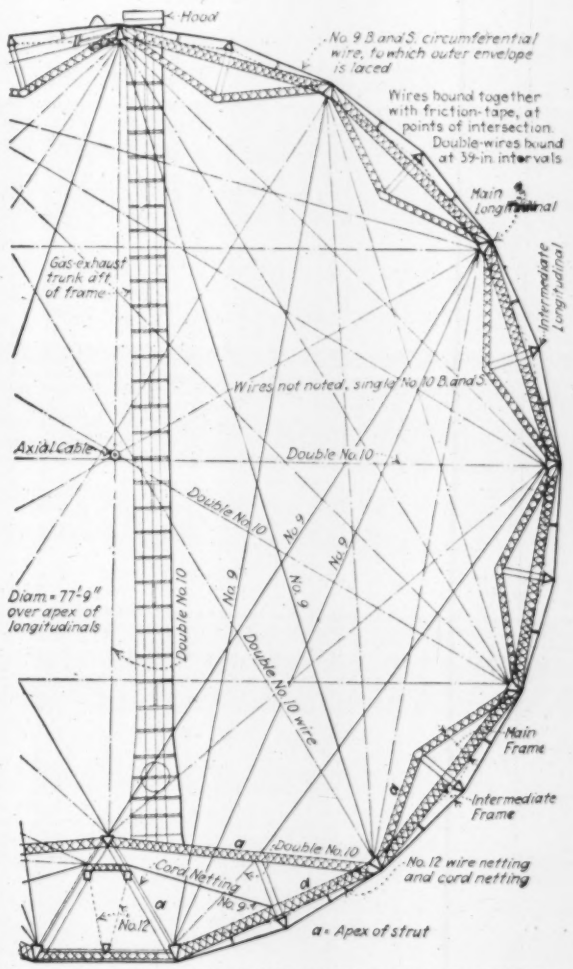

Hood
No. 9 B. and S. circumferential wire, to which outer envelope is laced
Wires bound together with friction-tape, at points of intersection. Double-wires bound at 39-in. intervals
Main Longitudinal
Intermediate Longitudinal
Gas exhaust trunk aft of frame
Wires not noted, single No. 10 B. and S.
Axial Cable
Double No. 10
Double No. 10
No. 9
No. 9
No. 9
No. 9
Diam. = 77'-9" over apex of longitudinals
Double No. 10
Double No. 10 wire
Main Frame
Intermediate Frame
Double No. 10
No. 12 wire netting and cord netting
Cord Netting
No. 9
No. 12
a = Apex of strut

FIG. 9—FRAMEWORK OF ZR1 IN TRANSVERSE SECTION

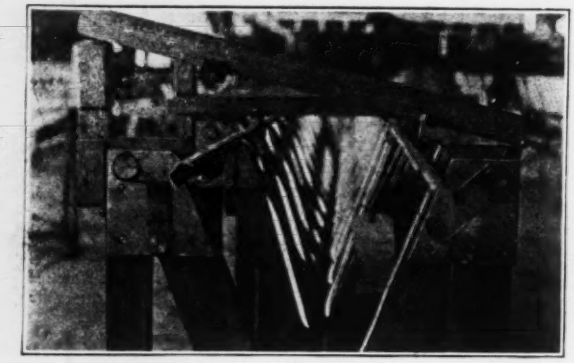
the carriage to a stop at the proper position for a rivet hole. As the table strikes the dog, it trips a clutch which actuates a cam shaft (on a stand on the floor beside the machine) by means of which four control motions are initiated in succession. The first presses a hold-down pad on the channel at the point of drilling, the second closes the drill circuit, the third feeds and returns the drill, and the fourth throws out the dog and sets the following one.

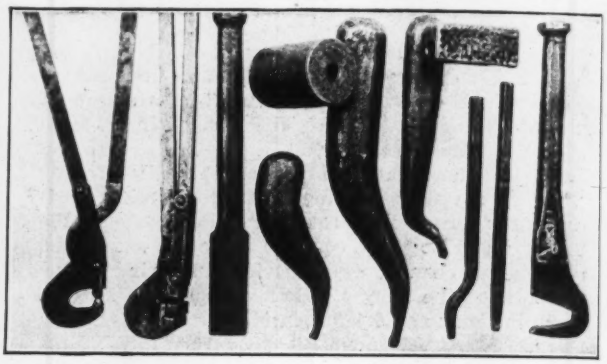
A high degree of precision is required in the work. An accumulated error of 0.006 in. on the 18-ft. length of a strut gives the finished strut a wind of $\frac{3}{4}$ in. in a 5-m. length. It was therefore considered necessary to limit the overall error in rivet holes in one channel to 0.002 in. To assure this degree of precision the stops on the machine were set up by the use of fixed end-gages corresponding to the various rivet spacings required.

With the channels drilled thus accurately and the lattice crosses assembled precisely by help of the fixture plate previously described, it is possible to assemble a strut in the open and obtain entirely satisfactory results. Quicker work can be done, however, by assembling it in a form. Such forms, as shown in Fig. 10, have therefore been used for most of the work. Before the parts of the strut are placed in the form, the peak channel is clamped, back down, on a base strip and the lattices of both sides are bolted to it, with bolts in half the total number of holes; the bolts are set up tight by screw-

driver. Similarly the two base channels are bolted to the bottom lattice, on a flat support. The two parts then go into the form, where the strut is assembled peak down and clamped. The empty holes are riveted and then the bolts are successively replaced by rivets.

Rivets are driven cold. The air-operated toggle riveting press (Fig. 7) is also one of the tools designed for the job. It has a 3-in. air cylinder, and with 85 lb. air exerts a pressure of about 3,000 lb. It is necessary to adjust the grip of this press (gap at full stroke) to the grip of the rivet to be driven, as greater closure would be likely to deform or cut the metal of the channel; this adjustment is made by changing the dies, various dies of suitable length being provided. The strut shown in Fig. 7 happens to be of square section, through the main framing of the dirigible consists of triangular struts.





FIGS. 10 AND 11—ASSEMBLING STRUT SECTIONS IN FORMS AND A GROUP OF HAND RIVETING TOOLS

Doubled latticing (successive lattice crosses half spaced) is provided at the ends and load points of those struts which have to carry transverse load, as occurs in a number of members in the keel section, and also in general where strength of joint is important. For the necessary inside attachment of alternate lattice members the in-turned edge of the channel flange must be straightened. This "lipping out" is done by a small press, or in individual cases by a hand tool shaped like a broad flat-nosed pliers (shown in Fig. 11). Lipping out tends to curve a channel concave toward its inner edge, but the operator can neutralize this tendency by bending the channel out during the operation.

Riveting—Three sizes of rivets are used in the structure, 0.0965 in. for the center connections of the lattice bars, 0.115 in. for the girder-lattice connections, and 0.154 in. for the joints. They are tempered before driving and must be driven within an hour following this treatment. In fabrication as well as erection the system was followed of collecting all undriven rivets at one-hour intervals and distributing freshly treated rivets.

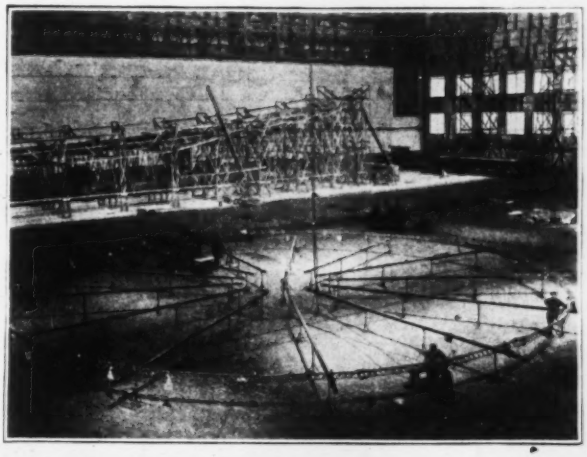
Joint Detailing—Details of typical connections were worked out on the drawing board in the course of the original design, but much of the detailing was left to the shop, to be worked out in actual set-up. No attempt was made to develop templets or shape the connection parts from the drawings, but all these data were worked out by shop set-ups or, as they were called, "mockups." Where a large number of duplicate joints was involved, all or part of the mockup was built with waste members or ends of members, and the details worked out with them thereafter were used as templets for laying out the total number of connection pieces required. Where only one connection of a given kind was to be made, it was usually worked out on the members themselves.

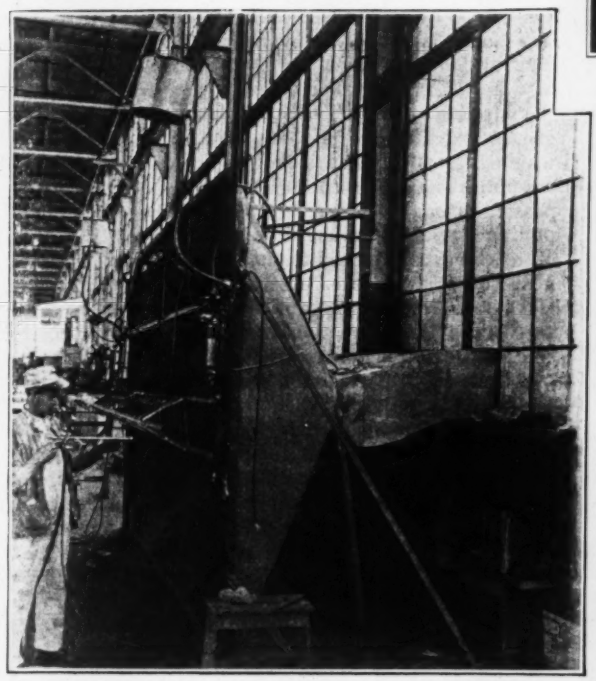
If the complexity of the joints involved in the airship structure is considered, it may be realized that the detailing of the joints was a very tedious and extensive item of the whole work. A number of joints may be seen among the accompanying views, and two mockups are shown. In the original drilling of the channels on the spacing table, the connections were in all cases left blank, and they were drilled later in the mockup or from the templet produced thereby.

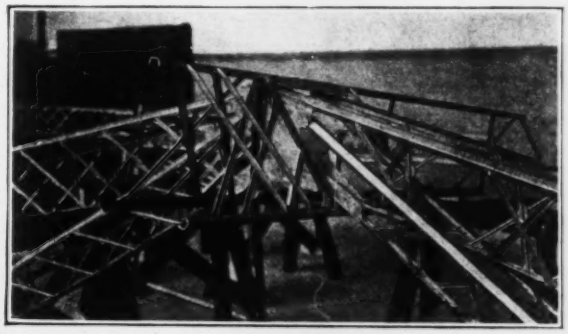
A special method of working out the joints was applied to the circumferential frames, which constitute the major part of the ship framing. A large floor jig was built for fitting up these frames at League Island, as shown in Fig. 14. Thirteen radial members, passing through the peak point of the frame, carry movable support plates, on which are mounted vertical angle plates in the line of the two adjoining circumferential members. The plates are set at the proper distance out for a given frame, and then the frame members are laid in position against the angle plate, marked for bevel, cut, and the joint details worked out. On this jig, finally, the connection plates were riveted to one of the two connected frame members and bolted to the other, the frame being subsequently disassembled and the individual sections shipped to Lakehurst for re-erection on a similar jig and final riveting and wiring.

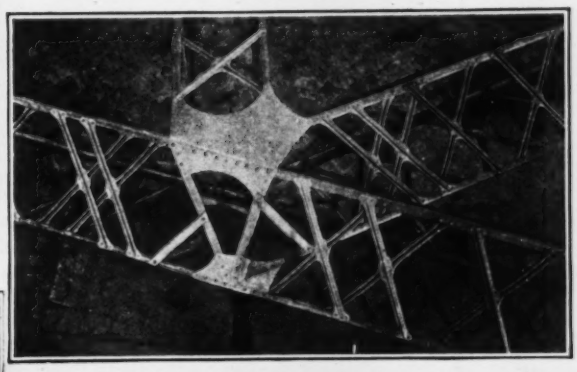
Several sub-assembly operations preceded and served this main assembly of the frame. Separate jigs were provided for these operations. On one the king post at mid-length of each main frame member was cut to bevel; on another the ends of the trussing struts of the king post frame were mitered, and on the third the trussed member was fully assembled. Connection plates and parts worked out from templets were also bent, cut and drilled in sub-assembly shops.

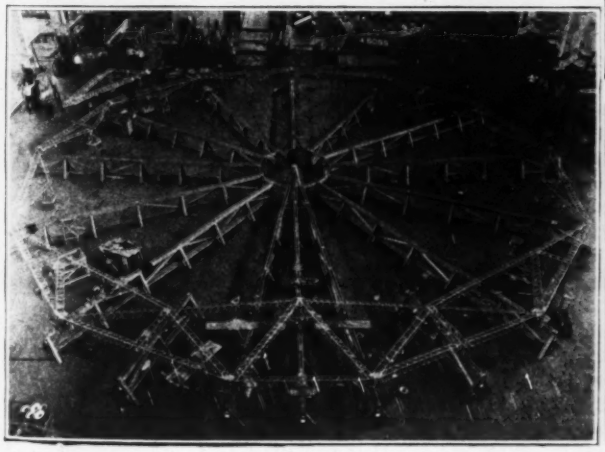
The main frame jig at League Island was adjustable for all frames, main and intermediate (the latter are 25-sided polygons in place of 13-sided as are the main frames, and their members are not trussed). After the early stages, however, to speed the work the intermediate frames were beveled and detailed by templet and were assembled on a loft floor, leaving the jig free for work on the main frames.

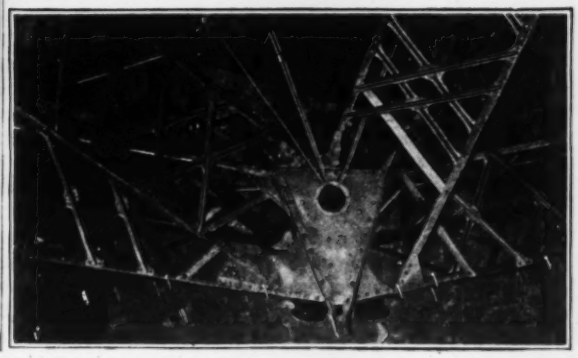












CONSTRUCTION OPERATIONS ON NAVY AIRSHIP ZR1

Fig. 12 (Top left)—"Mockup" assembly of joints for detailing.
Fig. 13—Varnishing struts with air spray.
Fig. 14—Main frame assembled at Naval Aircraft Factory.
Fig. 15 (Top right)—Intermediate frame in assembly at Lakehurst.
Fig. 16—A joint in mockup assembly.
Fig. 17—Frame joint, with double lattice near connection.
Fig. 18—Attachment of transverse wiring to joint of main frame.

FIG. 19—SERVED AND SOLDERED BRACE-WIRE LOOP

All completed members were varnished by compressed air spray (Fig. 13), using clear varnish with a small amount of blue pigment. Most of the material was shipped from League Island to Lakehurst by motor truck.

Final Assembly—A floor jig like that used at League Island but somewhat simpler in construction was built at Lakehurst for final assembly of the ring frames. Here they were riveted and the diametral and chord wiring which holds the ring to shape was inserted and drawn up to proper tension. With some care in handling, the completed frame could be picked up without serious distortion and handled by hoist lines suspended from the roof, over to the erection trestles, along one side of the big hangar, where it was set and blocked up, being lined up transversely and longitudinally by transit to true position.

FIG. 20—CENTRAL SECTION ERECTED AND BRACED

Erection—The system of erection differed from that used in England, where it has been customary to set and brace permanently a pair of frames, then skip a panel and erect and brace the next pair of frames, later filling in the empty panels. For the Lakehurst work it was decided that continuous working would be better, starting from a rigid mid-section to be first set and braced. Accordingly the middle six frames were set, the longitudinals put in place, beginning at the bottom, first in the middle panel and then in the panels to either side, etc., and finally the wire bracing between frames and longitudinals was put in in similar sequence. In this process the farthest advanced portion, at the middle, was at all times more rigid than the portions to either side, and disturbance or distortion was minimized by carrying on the work symmetrically toward either end of the group of frames. It was thus possible without great difficulty to maintain the framework true and thus finally produce a mid-section fully braced and true to form, with uniform tensions in the bracing wires. In this initial operation only the main frames and longitudinals were placed, and the secondary system with its secondary bracing followed as a second operation.

Once the rigid central section was complete, work could progress toward either end independently without any tendency to distortion.

Inserting the Brace Wiring — The wire bracing throughout the ship consists of hard drawn steel wire from No. 9 to No. 11 wire gage, with No. 12 and No. 13 used in some minor services. Turnbuckles are not used, but instead the wire is drawn up and end loops formed and safe-ended, with the use of a tensioning device which permits the application of precisely the tension wanted. The tensioning device consists of a small winding frame comprising a cable drum or spindle attached to a gear, and a crank handle attached to a pinion meshing with the gear; a pawl on the housing of the device engages a ratchet wheel on the pinion shaft. A vise-like clamp is connected by a link to the winding gear housing, and a similar one is attached to the outer end of a length of tiller rope which is wound on the drum of the winding gear. When a wire diagonal is to be put in, one end of the wire is passed through one of the eyes which it is to connect, a loop is bent, served with wire wrapping and soldered; then the other end of the wire is passed through its eye, and one of the clamps of the pulling device is attached to this free end, while the other clamp is attached to the standing part of the wire near the opposite eye. By means of the ratchet gear the connecting rope is wound up on the drum and the free end of the wire thereby pulled up to any desired tension. The tension in the standing part of the wire is measured with a Larson wire-tension gage while the pulling goes on, and when it reaches 300-lb. tension, the desired amount in the diagonals of this airship, the free end of the wire is clamped to the standing part, served and soldered. The serving is done with No. 30 annealed steel wire, put on in about 100 turns with a small space left every fifth turn. Without releasing the clamp, the serving is then filled with a flux of stearic acid and resin, and soldered and wiped. The result is shown in Fig. 19.

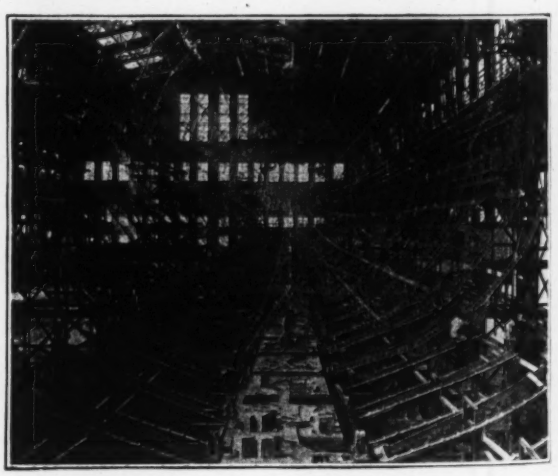


FIG. 21—ERECTION PROGRESSING TOWARD TAIL

Fitting Longitudinals—The field connections of longitudinals to the ring frame were drilled in the field; the end details were worked out fully in the League Island factory, and cut and formed, but the rivet holes were drilled in the member from the connecting holes in

frames and gusset plates when the longitudinal was actually built into the ship on the blocks.

Protection Netting and Skin—Each longitudinal element of the ship between main frames (10 m. long) is

FIG. 22—GASOLINE TANKS HUNG ALONG KEEL PASSAGEWAY

occupied by a separate gas bag. The bag has a manually operated escape valve at the top and an automatic release valve at the bottom, vented upward through a tube passing between the bags. To resist the bulging tendency of the bags in the openings between the frame members, the entire inner surface of the frame is covered with a tightly stretched network of crossed diagonal wires (No. 13) spaced about 18 in., which are fastened to the inner channels of the longitudinals and ring frames. Inside of these is a smaller netting of knotted ramie cord, about 9 in. mesh.

A skin of impregnated fabric covers the outside of the ship. It is put on in wide longitudinal strips, which are laced to the frame members around their edges. The spaces between the sections of fabric are covered with strips cemented on, and the entire skin is brush-coated with cellulose acetate.

Tests to Be Made—Wind and air resistance forces are applied to the airship structure through this skin. Buoyancy forces are applied by the retaining wire meshwork surrounding the gas bag, and bear chiefly on the frame members about mid-height of the structure. Loads other than the hull weight itself are due to the cars (power and control), fuel tanks hung along the sides of the keel passageway, and water ballast bags of one ton each in the same location. These vertical forces are applied partly at six panel points of the ring frames in the lower quarter, and partly along the length of intermediate longitudinals in the upper part of the keel section. The propulsive forces are exerted at the frame panel points to which the center and side power cars are fastened. Certain concentrated forces due to the action of the fins and rudder surfaces act on the tail section.

With the forces of attack on the structure thus concentrated at different points of the ship, knowledge of the way in which stresses distribute through the structure is of great importance. The difficulties of analysis in view of the very high degree of statical indeterminacy of the structure are, however, such that theoretical knowledge of the stress distribution is quite imperfect. On this account it is planned to make elaborate tests when the ship is completed. By comparison of the results of the stress measurement in these tests with calculation results, a high degree of approximation in correcting the theory is attainable.

Certain of the tests have already been made. One of them is illustrated in Fig. 24, showing one of the gas bags inflated, putting tension on the transverse wiring of the main frames at either end and correspondingly putting the frame itself in compression. Several thousand stress and distortion measurements were made in this test, or rather in a subsequent test of which this was the preliminary. For accurate measurement of distortions a wooden bridge, 85 ft. in span and 110 ft. high, was built over the test panel (Fig. 23) before the final gas-bag test was made. The results of the test agreed closely with calculations of ring stresses, as

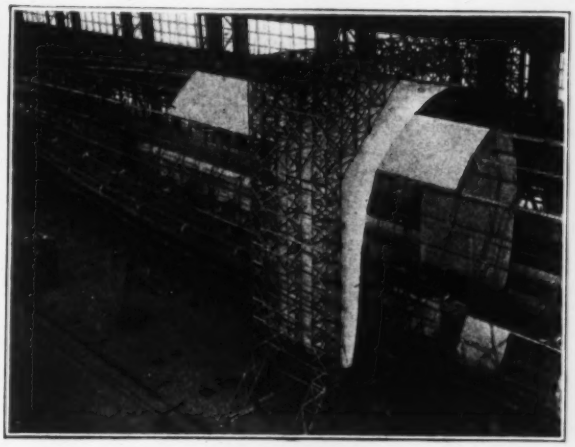


FIG. 23—BRIDGE OVER CENTRAL PART OF SHIP FOR GAS-BAG TEST; SPAN 85 FT., HEIGHT 110 FT.

might be expected if the structure was of reasonably uniform constitution.

In the tests after completion of the ship more significant results are likely to be obtained. These tests will be made under full buoyancy, with loads applied at definite positions along the keel and then shifted to other positions, giving a known change in bending moment. Comparison of the stresses measured for the two positions will give precise values of the stresses due to the increase or decrease in bending moment.

Local tests are being made on different parts of the structure. The tail stresses due to pressures on the fins are being investigated by measurement under known loads placed on the fins. It is probable also that tests in flight will be carried out. The McCollum-Peters carbon-resistance strain-gages of the Bureau of Standards (*Engineering News-Record*, July 5, 1923, p. 27) are used for the stress measurements. These gages permit making stress measurements at points inaccessible during the measurements and enable the readings from a large number of points to be taken at one central point.

Mechanical Problems—The various problems encountered in the equipment of the ship cannot be gone into here. One of them may be noted, however, to illustrate the original experimentation required in their solution.

The aluminum gasoline distributing piping in the ship is connected by fittings of sand-cast "linite," an

aluminum alloy. These fittings proved to be very porous; practically the entire lot leaked gasoline under a pressure test. The problem was to make them tight. Extensive experiments were carried out. Finally, success was attained by impregnating the castings with silicate of soda (water glass) under pressure. In the method finally used a lot of the castings are first subjected to a vacuum (25½ in. mercury was obtained), after which the water glass solution is admitted. The tank full of castings immersed in the solution is then subjected to a pressure of 300 lb. per square inch, which is left on for an hour. When taken out of the solution the castings are dried in the sun or at a gentle heat. The treatment makes them tight against gasoline in

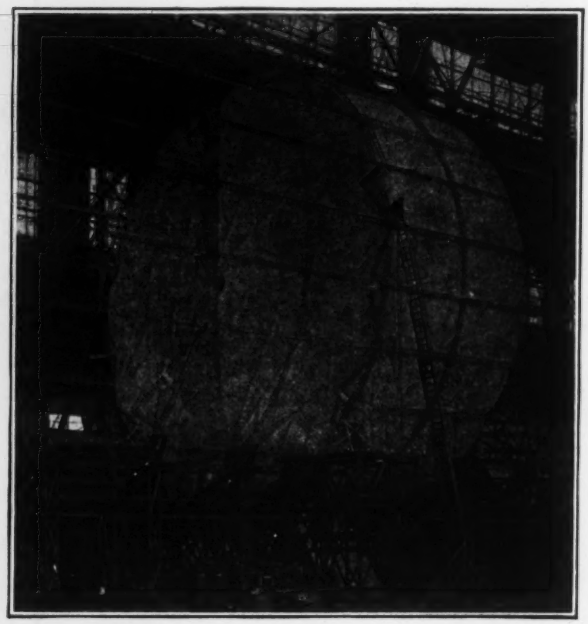


FIG. 24—GAS-BAG TEST OF TRANSVERSE WIRING AND FRAME RINGS

tests at 110 lb. pressure, which is several times as great as the highest service pressure.

It may be added that expansion is provided for in the longitudinal piping as well as in the wire and wire-rope lines of the control system, which operates valves of gas bags, ballast tanks, and the like, engine telegraphs, rudders and other necessary controls throughout the ship from the control car under the forward portion of the keel. The expansion provision in the pipes consists of goosenecks, while the wire and cable lines have mechanical take-up, also operated from the control car.

The general design of the Fleet Airship ZR1 was started under the direction of Commander J. C. Hunsaker, Construction Corps, U. S. Navy. The design of airships was under the cognizance of the Bureau of Construction and Repair. As chief of the bureau of construction and repair, Rear Admiral D. W. Taylor always displayed great interest in airships and due to his energy the work never lagged. Upon formation of the Bureau of Aeronautics, under Rear Admiral W. A. Moffett, the design of the ZR1 was completed under the direction of Commander Hunsaker. The detailed design, fabrication of parts of the structure and power plant installation were performed at the Naval Aircraft Factory, Navy Yard, Philadelphia, Pa., under the direction of Commander G. C. Westervelt, Construction Corps, U. S. Navy, its manager. The development of plant facilities, methods and processes of erection and tests of the ZR1 were performed under the direction of Commander R. D. Weyerbacher, Construction Corps, U. S. Navy, manager, Naval Air Station, Lakehurst, N. J.

Truck Sizes and Traffic Capacity of Highways

Extract from an address by Major F. S. Besson, Assistant Engineer Commissioner, District of Columbia, before the Washington Society of Automotive Engineers.

IN ORDER that the maximum capacity of highways may be developed, the widths of vehicles, with their loads, must be limited to 7½ ft. Likewise, in order to obtain this maximum capacity it would appear to be unwise to eliminate the 7½-ton truck, for its load would then be carried by more than one truck and more space would be occupied on the roadway.

A 7½-ton truck weighs, on the average, 11,000 lb. with no load, and 27,000 lb. loaded. Its average length over all is 21 ft. If its load is carried on 1½-ton trucks, five are necessary, the total weight of which unloaded would be 25,000 lb. compared to 11,000 lb. for the 7½-ton truck; and the length over all on the road would be 138 ft. compared to 21 ft. for the 7½-ton truck. Furthermore, we are not certain as yet, granted that the two types of trucks are equally well designed, that carrying the load on 20 wheels would not do more damage to the pavement than carrying it on 4 wheels. Certainly congestion on the streets would be greatly increased. Gross weight alone is not the all-important factor. Speed, unsprung weight, wheel loads, character of tires, tractive stress on the pavement, all these enter into the matter.

Pavements can be built at reasonable cost strong enough to carry 7½-ton trucks. Practically every pavement failure in Washington has been examined and in no case could blame be placed upon the heavy truck. Engineers need some unit upon which to base design and, having adopted the 7½-ton truck as this unit, the public should be informed that this limit is to continue indefinitely.

Within the permissible gross weights for vehicles, certain regulation is, however, required. A basic rule should be that trucks may not carry more than the weight for which they are manufactured, and in accordance with which weights the owners have paid fees in obtaining operating permits. The motor vehicle industry condemns overloading, and manufacturers generally are arriving at the point where they furnish caution plates stamped with chassis and body weights and load capacities. In accordance with the data furnished by the manufacturers, the license bureau should make certain that the permissible gross weights are painted on the sides of all cargo vehicles, and fees should conform to these gross weights.

It is believed fair to base registration fees for the time being on maximum gross weight alone, at 50c. per hundred pounds. Passengers should be rated at 150 lb. each. Thus, the usual 5-passenger car, weighing loaded about 3,200 lb., loaded would pay a fee of $16; a Ford roadster about $10; a heavy limousine probably $30; a 7½-ton truck, gross weight about 28,000 lb., $140.

These fees equal about the average paid throughout the United States, when gasoline, personal, and all other taxes combined are considered. The main principle of the suggested rate is that vehicles are taxed upon a graduated scale. It may not be absolutely accurate as judged from the pavement standpoint, but it is as nearly so as can be made under the present state of our knowledge. An important point is to enforce loading regulations.

New Gravity Freight Yard at Denison, Tex.; M.-K.-T. Ry.

Extensive Layout on Cutoff Line Has Daily Capacity for 80 Trains and Classifying 2,000 Cars—Two Hump Tracks Have Different Grades—Separate Departure Yards

OF MANY projects on the extensive improvement program which has been carried out during the receivership of the Missouri-Kansas-Texas Lines, the largest single undertaking is the new freight terminal at Denison, Tex., which it is expected to have complete and ready for service in August, 1923. Heavy concentration of traffic occurs at this place and the layout includes units for southbound and northbound movements. Each unit has a receiving yard and a combined classification and departure yard, these two yards being connected by a hump track. A special feature of the design is that provision is made for future development of a separate departure yard in each unit, to be located beyond the

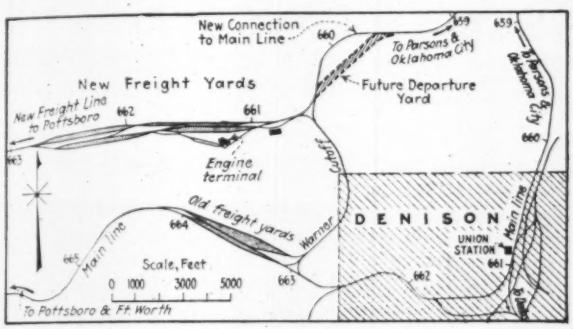


FIG. 1—NEW AND OLD FREIGHT TERMINALS AT DENISON, TEX.; M.-K.-T. RY.

classification yard. The general situation is shown in Fig. 1.

For some years past the old yard, built in 1894 and enlarged in 1909, has been inadequate for the traffic and the amount of classification required. In planning the improvement, consideration was given first to the expansion of the old facilities, but this would have required heavy grading and unfavorable alignment involving inconvenient and expensive operating conditions.

A new location was selected therefore about a mile from the old yard and requiring a new approach line. This site is much more favorable as to grades and curvature and is well adapted to a hump yard layout, since it has open rolling ground which descends with moderate slopes in both directions from a central ridge and is intersected by ravines which provide excellent lateral drainage. The axis of the yard is a tangent for more than a mile in each direction from the hump and the natural fall of the ground is favorable to the hump profile. In the six miles of new work, including a three-mile single track connecting to the main line at the south end, the length of freight main track is shortened by 1.3 miles, with a reduction of 235 deg. of central angle in total curvature and 72 ft. in rise and fall. This new work being entirely separate from the old facilities, its construction involves no interference with traffic and no disturbance of existing tracks. The new six-mile freight line leaves the Warner cutoff west of M.P. 660 (see Fig. 1) and joins the main line near M.P. 669, just each of Pottsboro.

Traffic Conditions—In the M.-K.-T. Ry. System, Denison is an important assembling and classification point. Studies showed that present traffic conditions require a yard of sufficient capacity to handle about forty inbound and forty outbound trains per 24 hours, and to switch and classify approximately 1,500 to 2,000 cars in the same period. Furthermore, the volume of traffic is increasing steadily and provision for growth was a prime requisite in the design of the new terminal.

Yard Layout—From the plan, Fig. 2, it will be seen that the northbound and southbound units are parallel with each other and that the two parts of each unit are in tandem, connected by the hump track. In the northbound unit the capacity of the receiving tracks is 69 to 92 cars and that of the classification tracks is 51 to 145 cars. In the southbound unit the receiving tracks hold from 86 to 121 cars and the classification tracks from 71 to 87 cars. The body tracks are spaced 13 ft. c. to c., and 16 to 18 ft. c. to c. from running tracks. Yard ladders have No. 8 frogs with a lead angle of 8 deg. 34 min. and a spacing of 84 ft. between points of switches. Turnouts from lead tracks also have No. 8 frogs. Rails of different weights are used at present, all laid on creosoted ties, with gravel and sand ballast for yard tracks and stone ballast on the connection to the main line. Drainage is provided by culverts crossing the yards, some of these being reinforced-concrete boxes 8 x 6 ft. with inlets 20 x 24 in. between the tracks.

Two caboose tracks holding 22 cabooses in all and a 12-car bad-order or cripple track are located alongside the upper or rear end of each classification yard, so as to be served by a minimum amount of switching. These tracks are 16 ft. c. to c. Between the two units and readily accessible from them are a car repair yard and a transfer platform for handling L.C.L. freight. South of the yard is the engine terminal, approached by running tracks from both directions. Yard tracks now under construction aggregate sixty miles and are divided as shown in Table I.

TABLE I—TRACK CAPACITY OF DENISON FREIGHT TERMINAL

Yard	Number of Tracks	Standing Car Capacity Maximum	Minimum	Total
Southbound receiving	6	121	88	600
Southbound classification	16	87	3.	1,200
Northbound receiving	10	92	69	700
Northbound classification	24	145	34	1,800
Car repair	4	17	14	65
L.C.L. transfer	4	18	18	75
Total				4,400

Interlocking plants protect the junctions of the new connecting line with the main line at Red River (Denison) and Pottsboro. An automatic switch set for southbound movements but opening under northbound trains (and returning to normal position) connects the northbound and southbound sections of the yard with the single track connection at the north end, near M.P. 660 (Fig. 1).

There are no highway crossings at grade within the yard limits. Two highways, one near the north end of the yard and one at the hump, are carried over the tracks on steel spans. One highway at the south end of the yard passes under the yard approach and switching lead through a concrete subway. Another over-crossing of timber trestle construction carries the main highway

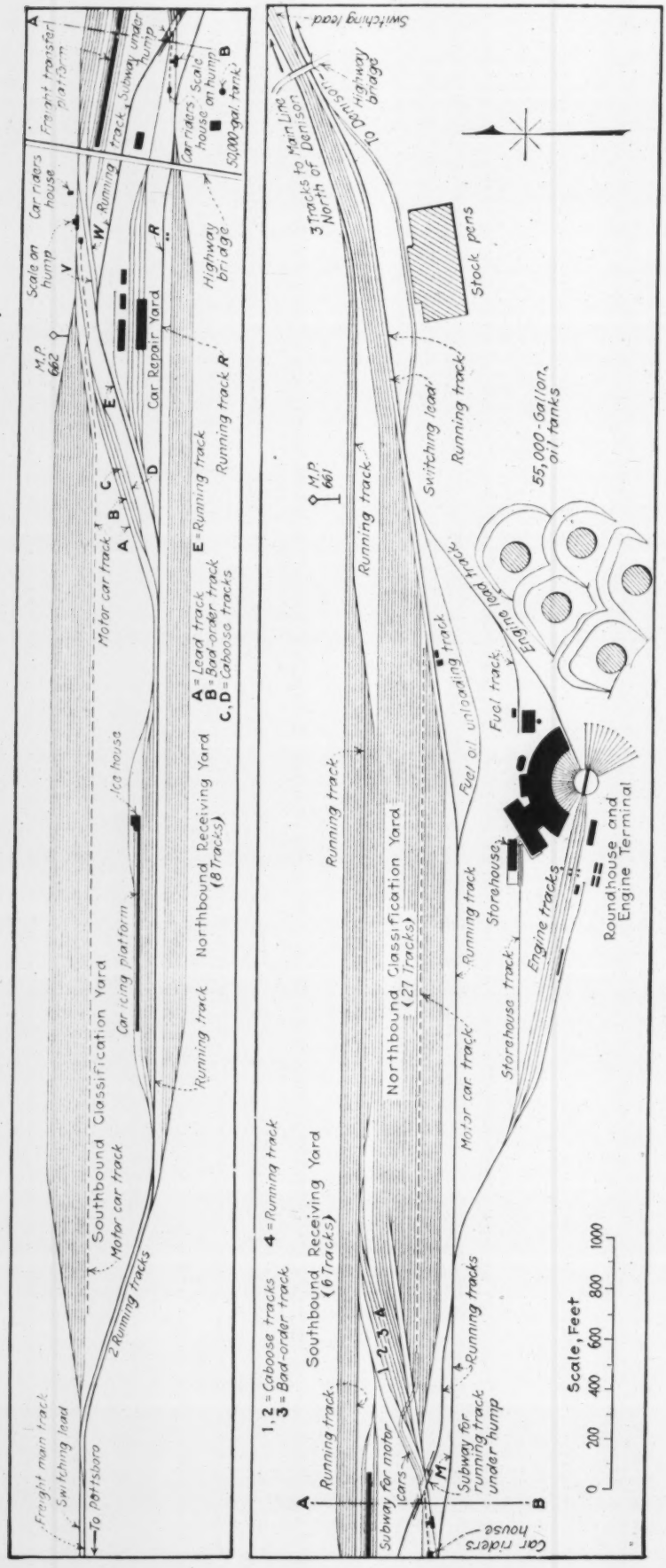


FIG. 2—LAYOUT OF FREIGHT YARDS AT DENISON, TEX.

over the single-track freight main line which connects the south end of the yard with the Fort Worth division of the main line, five miles west of Denison.

Switching Humps—The two humps are nearly opposite each other and about 600 ft. apart, each with a 56-ft. 75-ton track scale conforming to the specifications of the U. S. Bureau of Standards. Their profiles are as shown in Fig. 3 and in Table II, the slightly steeper grade of the northbound hump being due to the larger proportion of empty cars in that direction. In each yard a track is provided for the operation of motor cars to return the car riders to the hump. In the southbound yard this track is located at the side of the body tracks but in the northbound yard it is located in the center, crossing under the classification lead through a concrete subway.

A considerable proportion of the traffic terminates or originates in Denison or on branch lines centering there. As this traffic comes from or is destined for points both north and south on the main line there is a certain amount of reverse movement of such cars. To meet this condition provision is made for convenient cross movements of cars over either hump, without separate switching, into tracks so located that cars can be classified in reverse direction over the other hump. It is expected that when traffic is light both humps will be operated by a single engine.

To control the movements of the hump engines, electrical signals, operated from the humps, are placed on the steel spans which carry the highway over the hump tracks. The switches of the classification tracks are thrown by hand.

Miscellaneous Yard Facilities—Transfer for L.C.L. freight in order to consolidate shipments is provided for by a timber platform 24 x 600 ft. having an office and locker room. This platform, Fig. 4, serves two tracks 12 ft. c. to c. on each side. Creosoted pile butts on concrete footings carry joists 10 ft. apart on which are stringers for the 2⅝-in. floor planking. Along each side of the platform a trucking runway is formed by a pair of 10-in. steel plates ⅛ in. thick, the floor being grooved so that these plates are flush with the surface. Two-post bents 20 ft. apart carry stringers for the joists of the butterfly roof. By inclosing three bays of these bents, an office 10 x 60 ft. is formed and the lighting and ventilation of this inclosure is assisted by a triangular skylight with hinged sash, as shown.

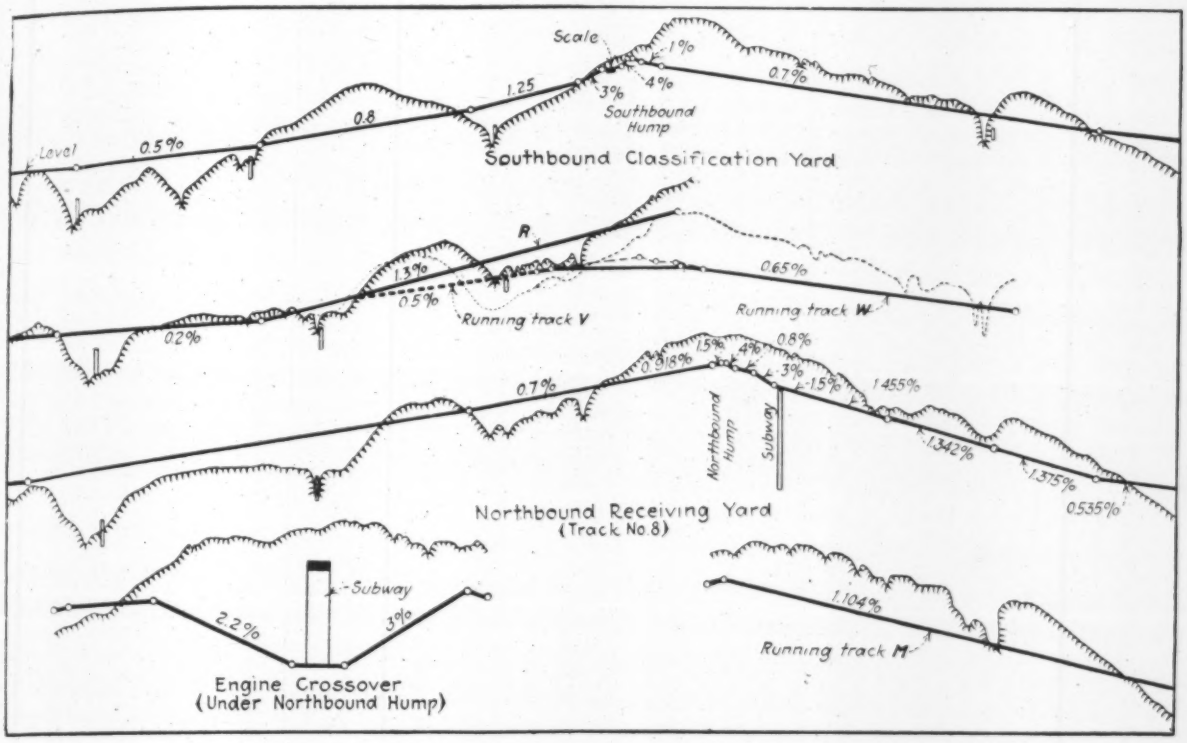


FIG. 3—PROFILES OF SWITCHING HUMPS

An icing station along the north side of the northbound receiving yard comprises a 100-ton ice storage house of frame construction, an ice crusher, conveyors and a double-deck platform 16 x 800 ft. for delivering block or crushed ice to the bunkers of refrigerator cars. This plant serves two tracks 29 ft. c. to c. Stock pens are provided for unloading and feeding stock in transit.

Car repair facilities are provided at four tracks spaced 16, 20 and 24 ft. c. to c., two of which are covered by a shed 200 x 40 ft. There are also a lumber shed, small shop, office and storeroom, served by a material track at the rear. Compressed air is piped from the power house to the repair tracks and also to the departure tracks for testing the train brakes. A two-story brick yard office is located midway between the humps, giving a good view of the entire yard and convenient access to the humps and the transfer platform.

TABLE II—PROFILES OF SWITCHING HUMPS IN YARD AT DENISON, TEX.; M.-K.-T. RY.

	Northbound Hump	Southbound Hump
Ascent from receiving yard	0.7 and 0.98 per cent	0.70 per cent
Bunching grade at summit	1.5 per cent for 50 ft.	1.0 per cent for 100 ft.
Bunching grade at summit		1.5 per cent for 50 ft.
First accelerating grade	4 per cent for 75 ft.	4 per cen for 50 ft.
Over scale	0.8 per cent for 100 ft.	0.8 per cent for 100 ft.
Second accelerating grade to ladder	3 per cent for 100 ft.	3 per cent for 100 ft.
On classification ladder	1.5 per cent for 250 ft.	1.25 per cent for 500 ft.
On classification ladder	0.435 per cent for 300 ft.	
On classification tracks	1.342 for 500 ft.	0.8 per cent for 1,000 ft.
On classification tracks	1.375 for 500 ft.	0.5 per cent for 900 ft.
On classification tracks	0.536 for 500 ft.	Level
On classification tracks	0.38 for 1,000 ft.	
On classification tracks	Level	

Engine Terminal—The locomotive facilities, arranged at the south side of the yard, include a 100-ft. deck turntable of center-bearing type operated by an electric tractor, and a 22-stall brick and frame roundhouse 105 ft. deep with shop annex 72 x 225 ft. There is no through track, the roundhouse being served only by the turntable. This turntable also serves twelve radial tracks opposite the roundhouse. All the radial tracks are at an angle of 5 deg. 48 min. 23 sec. The layout of the engine terminal is shown in Fig. 5.

Concrete engine pits 79 ft. long provide for inspection and repair in the roundhouse, Fig. 6. A drop pit for handling driving wheels and axles serves the three tracks which extend into the shop, and two of the other tracks are served by a smaller drop pit for truck wheels. Four post cranes are located adjacent to the larger drop pit. The roundhouse floor is of concrete. Wooden swinging doors form the inner front of the building, and the outer or rear wall has a large proportion of glazed area. In the middle of the roof of the roundhouse is a high and wide cupola or monitor, with ventilating sash.

The shop, of brick and steel construction, is divided into two parts by 50-ft. working pits in three of the roundhouse tracks which are extended into the shop. At one end of the shop are the machine tools and the other end is used for blacksmith and tube work. A 10-ton electric overhead crane travels the entire length of the shop and handles materials between the locomotives and the machines.

This shop building is connected also by a covered passage with the concrete and brick store and oil house, 60 x 120 ft. The floor of the store house and the adjoining platform are at the same elevation as the shop floor and the track serving them is depressed so that the car floor is level with the platforms. This arrangement of all facilities under one roof and at one floor level provides passage between roundhouse, shop and store house with a minimum of man-travel. Windows in the shop buildings and roundhouse have steel sash glazed with factory wire glass. The roundhouse cupola has wood sash. The roundhouse and shop are

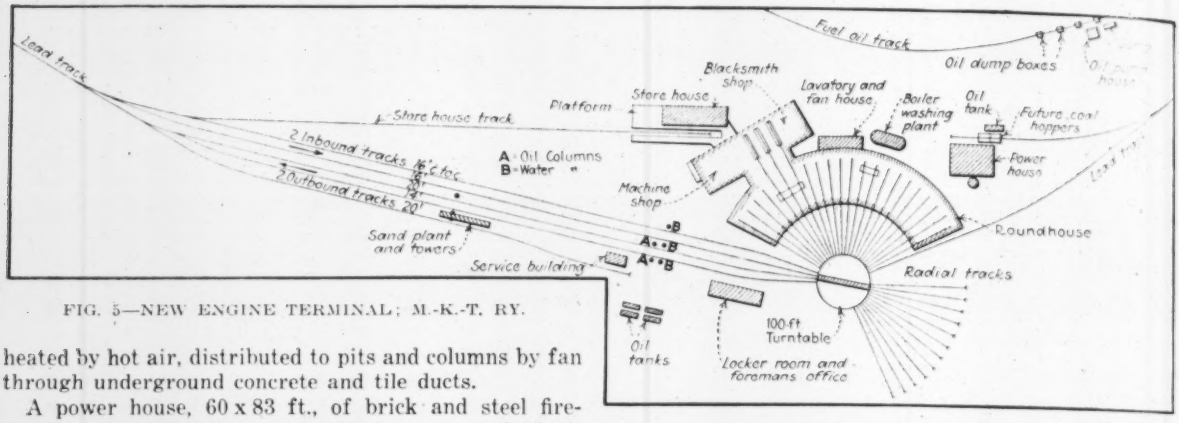


FIG. 5—NEW ENGINE TERMINAL; M.-K.-T. RY.

heated by hot air, distributed to pits and columns by fan through underground concrete and tile ducts.

A power house, 60 x 83 ft., of brick and steel fireproof construction, houses two 328-hp. water-tube boilers, two steam-driven compressors each with a capacity of 1,000 cu.ft. per second, together with fire pumps and other accessories. Electric power for operating machinery and for lighting the yard is purchased from the local power company and the power house will not contain any prime movers for the present, steam being provided only for operation of the compressors, the heating plant and the boiler washing plant. The boilers use oil fuel, but the power house is designed to accommodate future coal and ash handling facilities. A lavatory and locker room and a fan room for the heating system adjoin the back of the roundhouse, and the boiler-washing plant is housed in a separate structure.

Fuel and Water Supply—Oil fuel is used by all locomotives operating out of this terminal and is supplied to the tender tanks by two oil columns near the roundhouse. Fuel oil is dumped from tank cars at eight oil boxes (see *Engineering News-Record*, 1921, Aug. 4, p. 183, and Oct. 13, p. 618) and is stored in five 55,000-barrel steel tanks which are surrounded by low earth banks for fire protection. From storage, the oil is pumped to four 10,000-gal. elevated horizontal delivery tanks, which serve the oil columns. There is a sand-house and drier and the plans provide for a future coaling station and ash handling facilities when these shall be required.

Water is purchased from the city and delivered through a 10-in. main to a steel tank 115 ft. in diameter and 30 ft. high, of 2,300,000 gal. capacity, erected on a hill about 900 ft. south of the roundhouse and with its bottom about 75 ft. above rail level. This tank supplies emergency storage and direct pressure for delivery of water to the engines. An elevated steel tank of 40,000 gal. capacity, opposite the humps, provides a service supply in the buildings and also supplies two water columns located along running tracks adjacent to the humps.

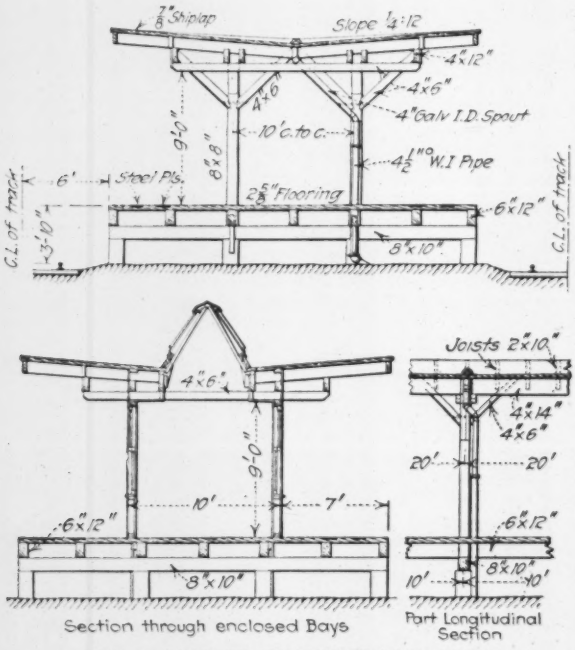


FIG. 4—FREIGHT TRANSFER PLATFORM
Note trucking runways of steel plates

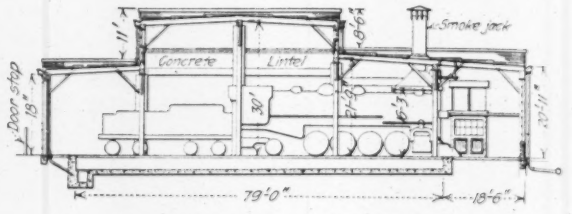


FIG. 6—SECTION OF ROUNDHOUSE

Engineers and Contractors—Grading for the yard and locomotive terminal involved about 800,000 cu.yd. Culverts and bridges comprise 7,850 cu.yd. of concrete. The grading and concrete work was performed by the C. R. Cummins Co., Cleveland, Ohio; and Bowie, Lydon & Co., Chicago, were general contractors for the building work. Three oil tanks and the water storage tank were constructed by the Chicago Bridge & Iron Works, Chicago, and two oil tanks by the United Iron Works, Kansas City, Mo.; fuel oil facilities and boiler washing plant, by the National Boiler Washing Co., Chicago; water and air pipe lines and stock pens, by T. H. Johnson, Sedalia, Mo. Tracks are being laid and ballasted, including the furnishing of sand ballast for yard tracks, by Zay Gardner, McAlester, Okla. The cost of the whole project will be about $3,200,000.

This improvement was planned and is being carried out under the supervision of F. Ringer, chief engineer, Missouri-Kansas-Texas Ry., assisted by J. M. Metcalf, principal assistant engineer; with A. L. Sparks, architect, in charge of preparation of building plans, and A. Harvey, construction engineer, in charge of the work on the ground.

Hammer Rigged to Follow Pile Down Under Water

Lumber Saved and Submarine Sawing Minimized on Foundations for Brooklyn Edison Power Plant Construction

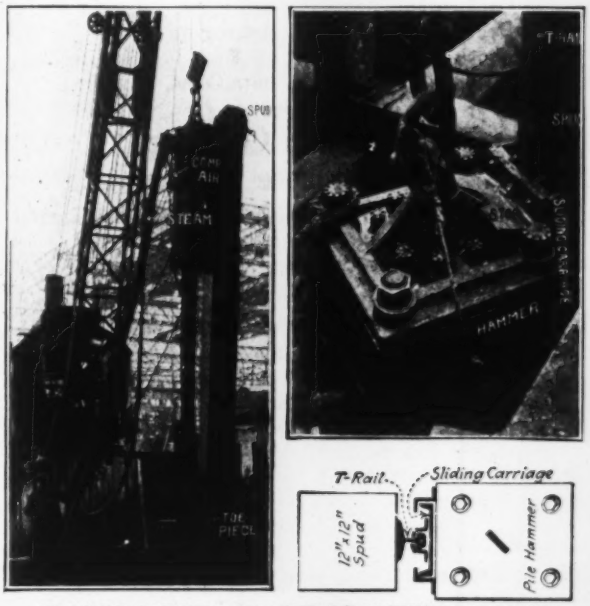
BY THE USE of a rig which makes possible the driving of wood piles with a standard steam hammer submerged in water 30 to 40 ft. deep foundations have been prepared for the large new power plant along the East River, at the foot of Hudson Ave., for the Brooklyn Edison Co., New York City. The outstanding feature of the scheme of submarine driving is the mounting of the hammer on a long timber spud equipped with a T-rail track and a sliding carriage which allows the hammer to move down under water with the pile head to grade. Thus the use of a follower frequently employed in submarine driving of this sort is dispensed with, the full force of the blow of the hammer is delivered direct to the top of the pile, the costly operation of sawing off piles to grade under water is largely eliminated and short lengths of pile can be used effectively with little or no waste of lumber.

The Brooklyn work involved the driving of piles in 11 cofferdams containing heavy timber cross-bracing which divides the cofferdams into groups of rectangular pockets. The bottom is composed of sand and gravel. The foundation requirements called for piles having a penetration of from 15 to 25 ft., spaced on about 2-ft. centers. With the submarine rig described below 3,000 piles have been driven in three of the cofferdams. In the other cofferdams long piles were driven and cut off with a saw as described in *Engineering News-Record* of March 22, p. 548.

Sliding Carriage for Hammer—To avoid the necessity of unwatering the cofferdams, which would have brought great pressure on the interlocking steel sheet piling of which they are formed, the plan of submarine pile driving was decided upon. For this work, a submarine rig was developed consisting of a McKiernan-Terry steam hammer weighing 6,600 lb. mounted on a sliding carriage which, in turn, engages a vertical T-rail track attached to a 12x12-in. timber spud about 55 ft. long. The sliding carriage consists of a steel channel to which Z-bars are riveted to engage the head of the T-rail and the sides of which are, in turn, engaged by a second pair of Z-bars riveted to the back of the hammer. There is a stop riveted to the top of channel carriage to prevent the hammer from being pulled out of its guides, a similar stop at the upper end of the spud to limit the upward movement of the carriage, and a toe-piece at the bottom of the carriage, consisting of a pair of steel straps drilled with holes large enough to receive large spikes. The function of this toe-piece, through which one spike is driven from each side into the wood pile, is to hold the lower end of the pile in position, prior to the operation of the driving, and to guide it in its descent.

Wooden piles with 12 to 14-in. butts are delivered on barges alongside a scow within reach of a locomotive crane from the boom of which the piledriving equipment is suspended by a two-part wire cable. The operations preliminary to actual driving consist in sawing the wood piles to the proper length (15-25 ft.) by hand and shoeing them with metal points. A chain hitch is then passed around the pile and it is snaked to position under the hammer which is raised as high as the stops on the channel carriage and the spud will permit. The top of the pile is then fitted under the bell-bottom anvil block of the hammer, the foot of the pile is swung into the U-shaped opening formed by the sides of the toe-piece, and two spikes, one from each side, are driven part way into the pile through the holes in the toe-piece to hold the pile point in line. The spud is then accurately spotted by the derrick boom, brought to a vertical position and held there by guy lines. The hammer on its sliding carriage is lowered until the pile point strikes bottom; in this position the hammer is completely submerged, although the spud is long enough so that its top is well above water level.

The first few blows of the hammer force the pile



HAMMER CARRIED ON SPUD BY SLIDING CARRIAGE
Cross-section shows carriage and track details.

down through the toe-piece, turning up the spikes and disengaging their grip. The hammer then follows the pile down through the water along its sliding carriage until the top of the pile reaches grade. The exhaust steam is led to the surface through a rubber hose. The hammer and spud are raised and the operation is repeated.

The Hammer—The hammer is of the double-acting type, operated, in this case, by steam at a pressure of about 100 lb. per square inch. The hammer has overall dimensions of 20x20x87 in., a cylinder bore of 8½ in. and a stroke of 16 in. It weighs, with its base, 6,600 lb. and delivers 140 strokes per minute. The energy per stroke is 7,700 ft.-lb. This is a standard model of hammer, but for submarine work it is equipped with a hose connection to supply compressed air to the bottom cylinder to compensate for the water pressure when the hammer is submerged. This prevents water from entering the cylinder and interfering with the reciprocating movement of the ram.

With this rig the number of piles driven in water 30 to 40 ft. deep average about 30 in an 8-hour day. The driving crew consists of 8 men, distributed as follows: 4 on the guides; 2 sawing piles to proper length and attaching shoes; 1 on the hoist; and 1 to regulate the

compressed air. Divers sent down to inspect the work reported that the piles were driven to grade without brooming and were accurately spaced. Only occasionally was it necessary to do any sawing off under water. One of the chief advantages of this method of submarine driving is that, even in deep water, long piles are not needed to extend above the surface; the length of piles with this rig need be only a foot or so more than the actual depth of penetration.

Advantages of Method—Summing up the advantages of the method, these points are made: Shorter piles, with saving of lumber; elimination of a follower; full force of blow delivered direct to pile head; piles driven straight; piles accurately spaced by means of spud; no need of unwatering cofferdams for driving; no delays on account of high water; divers not required except for inspection and occasional sawing off.

The work described is being done for the Brooklyn Edison Co. by the Frederick Snare Corp., New York City.

Conclusions From Core-Drill Tests of Concrete Roads

New Jersey Records Furnish Unexpected Information on Influence of Reinforcement and Nature of Cracks

By R. B. Gage
Chemical Engineer, State Highway Commission, Trenton, N. J.

CORE drills make it possible easily to determine the strength, character and thickness of any concrete pavement or foundation. The samples taken represent the concrete better and supply more data than cylinders or cubes cast during construction. The location of reinforcing metal, the character of expansion or construction joints and the nature of cracks can easily be determined. This equipment has also made it much easier to detect errors in construction and determine the causes than was possible before its use. The general conditions, governing the construction of pavements, as interpreted from the cores cut to date, may be classed as follows:

1. The thickness of a concrete pavement or foundation will not vary from the thickness specified more than ½ in., if the contractor performs his work in the manner required. When the thickness of the pavement departs more than this amount from that specified, it is very good evidence of careless workmanship.

2. There does not appear to be any definite relation between the strength secured on samples prepared during construction and the strength test shown by the cores cut from the same pavement after construction. The variation is so marked that it has been deemed advisable to discontinue taking sample cubes or cylinders during construction and depend altogether upon the cores taken after construction to determine the character and thickness of the concrete.

3. The position occupied by reinforcing fabric or bars is definitely shown. Reinforcing metal that was supposed to be installed from 2 to 3 in. from the base of the pavement has frequently been found resting on the subgrade

4. The character of the concrete beneath a reinforcing fabric frequently differs from that on top of the fabric in that it does not have the same density.

5. The porosity of the concrete appears to increase as the slump decreases. The quantity of porous concrete appears to be much greater in pavements containing reinforcing metal than in those not so reinforced for the reinforcing metal has a tendency to bridge over the concrete and form openings.

6. The quantity of porous concrete increases with the size of the aggregate, other conditions being the same.

7. Stone aggregate is more prone to bridge and form openings around reinforcing metal than gravel.

8. Cores cut on tranverse expansion joints have shown that the bitumen in a premoulded joint filler often is completely squeezed out, leaving only the felt or paper edges; also that there is practically no adhesion whatever between the concrete walls of the joint and the surface of the joint filler.

9. Another important fact, demonstrated to date by the core drill is that cracks are more prone to form in concrete having a low crushing strength than in concrete that has a high crushing strength. The general character of the cores also indicates that the higher the crushing strength, the better the concrete is able to resist the ravages of travel and climatic changes.

10. In order that the different errors in construction may be reduced to a minimum by correcting them as soon as possible after they are made, it is recommended that all concrete foundations and surface pavements be sampled during construction as soon as the concrete has attained sufficient strength to permit the cores to be cut and the crushing strength of these cores determined when they are 28 days old. Such a method of sampling will be much more satisfactory than to wait until the construction of a pavement or foundations has been completed or partly completed. If this procedure is followed, a contractor will soon know, after his job is completed, whether his work is to be accepted at par or at a reduction in price.

11. It has generally been assumed that most of the transverse cracks in concrete pavements start from the bottom of the slab and work to the surface. Some of the cores cut indicate that just the reverse is true. Cores cut on well defined surface transverse cracks, which extend completely across the pavement, showed that the cracks did not extend the full depth of the pavement. In some instances, these cracks have extended through two different lines of reinforcement; other cracks have extended through only single lines of reinforcement. The reinforcing metal appears to prevent longitudinal cracks from opening up; but it is very difficult to tell as yet from the cores cut whether a reinforcing metal decreases the number of cracks in the pavement or not. They do appear, however, to indicate that more benefit would be secured by placing the reinforcing metal adjacent to pavement surface than to base.

New Hudson River Power Plant

The Moreau Manufacturing Co. has just announced that it is about to undertake a new power development on the Hudson River just above the Sherman Island development, now nearing completion for the International Paper Co., above Glens Falls. This new development, which is to be partly used by the International Paper Co., is called the Cedar Dam Hydro-Electric Development. It will utilize 17 ft. of head with preliminary output of 7,500 hp. and a final one of 12,000 hp. The work is in charge of A. H. White, engineer, for the International Paper Co., and is to be done by the Parklap Construction Co., which is also completing the Sherman Island development.

Analysis of Attendance at Engineering Schools, 1921-22 and 1922-23

Abstract of a paper presented before the annual convention of the Society for the Promotion of Engineering Education, Ithaca, N. Y., June 20-23, by Walton St. John, specialist in rural and technical education, United States Bureau of Education, Department of the Interior, Washington, D. C.

THE Bureau of Education has collected educational statistics of engineering schools for several decades. These statistics have been published in recent years as a part of the biennial survey of education and consequently are from one to two years old before they reach the public. Engineering statistics of State-controlled universities and colleges have been published annually but these data necessarily are a year old or more before publication.

In order to overcome the delay in obtaining these statistics the Bureau of Education with the co-operation of the Society for the Promotion of Engineering Education has obtained the enrollments in engineering schools for the year 1921-22, and 1922-23. The enrollments have been obtained for the first semester of each year, and tabular summaries of these enrollments have appeared in the journal of the Society.

With these figures it has been possible to ascertain the enrollments of the graduating classes in the several branches of engineering and also to predict with some degree of assurance the enrollments of the graduating classes for the year following.

There are 133 engineering schools which report to the Bureau of Education, but the data of this study are based upon the reports of only 129 of these institutions.

The table given below shows that losses are recorded in the five leading branches of engineering, the per cent of loss varying as follows: mining engineering and metallurgy, 8 per cent; mechanical engineering, 11 per cent; civil engineering, 12 per cent; electrical engineering, 5 per cent; chemical engineering, 24 per cent. The other branches of engineering taken together record a gain of 20 per cent.

COMPARATIVE ENROLLMENTS IN ENGINEERING SCHOOLS FOR THE YEARS 1921-22 AND 1922-23

Based on enrollments during the first semester of the year

Curriculum or Course	Year	Freshman and Sophomore Years	Junior Year	Senior Year	Total
Total Enrollment	1922	35,738	11,834	9,157	56,729
	1923	31,472	10,823	9,995	52,290
		−4,266	−1,011	+838	−4,439
		−12%	−9%	+9%	−8%
Civil Engineering	1922	8,065	2,695	2,078	12,802
	1923	6,761	2,433	2,018	11,212
		−1,304	−226	−60	−1,590
		−16%	−9%	−3%	−12%
Mechanical Engineering	1922	9,105	3,005	2,343	14,453
	1923	7,774	2,637	2,481	12,892
		−1,331	−368	+138	−1,561
		−15%	−12%	+6%	−11%
Electrical Engineering	1922	8,363	2,961	1,951	13,275
	1923	7,613	2,658	2,360	12,631
		−750	−303	+409	−644
		−9%	−10%	+21%	−5%
Chemical Engineering	1922	4,444	1,406	1,204	7,054
	1923	3,207	1,082	1,097	5,386
		−1,137	−324	−107	−1,668
		−26%	−23%	−9%	−24%
Mining, Engineering and Metallurgy	1922	1,824	481	590	2,895
	1923	1,545	514	602	2,661
		−279	+33	+12	−234
		−15%	+7%	+2%	−8%
All other branches	1922	3,938	1,322	991	6,251
	1923	4,570	1,499	1,437	7,506
		+632	+177	+446	+1,255
		+16%	+13%	+45%	+20%

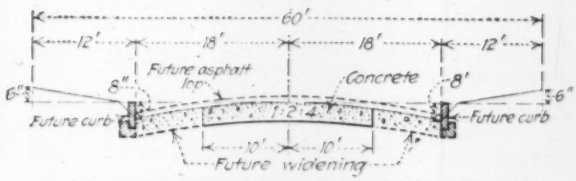
In a comparison that has been made between the enrollments in the junior and the senior classes for the year 1922-23, it was found that there was an average loss of 16 per cent in the senior classes. For 1922-23 the junior classes average 9 per cent less than for 1921-22. Therefore the total senior enrollments for 1923-24 will be about 9 per cent less than for 1921-22 and will approximate 9,100, the senior classes having enrolled 9,955 for 1922-23.

The relation of the number of students in schools of engineering to the enrollments in the secondary schools and also to the total number of students in universities, colleges and special training institutions (including in this group all schools requiring for admission graduation from a secondary school) is as follows for the year 1919-1920:

	Per cent
Percentage of engineering students, 51,908, in relation to total male enrollment in secondary schools, 1919-1920, 1,114,833	4.7
Percentage of engineering students, 1922-1923, 52,290, in relation to total male enrollment in secondary schools, 1919-1920, 1,114,833	4.8
Percentage of engineering students, 51,908, in relation to total male enrollment in universities and colleges, 1919-1920, 324,977	16.0
Percentage of engineering graduates, 9,157, in relation to male secondary school graduates, 1919-1920, 101,106	9.0

Partial Pavements for New Subdivisions

STREET improvement practice in subdivisions has been modified in some instances recently, in St. Louis, Mo., by substituting what is virtually rural concrete-road construction for standard city pavement extending the full width between curbs. The accompanying sketch indicates the construction and its future incorporation into a full-width pavement. The advantage of the plan is, first, economy—a paved roadway is secured without an excessive cost burden on the bordering unimproved building lots. Second, spaces are left on each side for installing underground conduits and house services without tearing up pavement. The third advantage is that the original pavement is fully capitalized as a major part of the base for a full-width pavement. As the subdivision builds up and standard city paving is warranted, the old concrete is widened on each side, curbs are built and a bituminous surface is spread over the old and new concrete between curbs.



PARTIAL PAVEMENT, ST. LOUIS SUBDIVISIONS

In the original construction, of course, the concrete slab is built to grade as established by the Board of Public Service of St. Louis and from plans by and under inspection of the engineers of the Board. While the partial-pavement type of subdivision street improvement is not required—companies developing subdivisions sometimes preferring to pave and curb the full street width—it is advised, and, in a number of instances, has been adopted, it is believed, to considerable advantage to those buying and building in the new settlement. W. W. Horner, engineer, Board of Public Service, has been largely instrumental in creating the new practice.

Highway Progress and Problems in the Mid-South—III

South Carolina North Carolina
Virginia West Virginia
Kentucky Tennessee
Missouri

Seven Southern States Contemplate Road Expenditures Approaching a Billion Dollars—Automobile License Fees and Gasoline Taxes Will Provide the Money—Editorial Review Based on Studies in the Field

This is the third article of the series. The first article, on Group Problems and the two Carolinas, appeared in "Engineering News-Record of July 26, 1923, p. 128 and the second article, on the two Virginias, appeared in the issue of Aug. 2, p. 168.

Kentucky and Tennessee

IN THE similarity of their highway problems, Tennessee and Kentucky are more nearly twin states than are the two Virginias or even the two Carolinas. Both have about the same traffic, physical, and financial conditions. In Kentucky centralized state direction is most advanced but the effects of recent county domination are still felt. In Tennessee county co-operation in state road development remains a dominant factor. The population is about equally sparse and traffic is overwhelmingly local; not over 2 per cent of the vehicles recorded in traffic counts are foreign to the county in which the counts were made, considering the average for the state.

Finance and administration are the outstanding highway problems. Both states lack development of inter-county and across-state routes. Their present funds scattered about among the counties promise no immediate system development of continuous routes. There have to be larger expenditures and they have to be controlled by the state highway department to build up a connected system of roads if either state is soon to take rank among states which lead in highway development.

Kentucky

Recovering from Local Control

Despite legislation in 1920 which established strong centralized state direction of road improvement, Kentucky has a legacy, from past county direction, of debt and unrelated improvements which presents a difficult problem. Without a large increase in road funds its solution will, indeed, be long delayed. Comprehensive highway financing is the pressing need of the Blue Grass State.

In its general aspects the situation in Kentucky is typical of a situation rather general in southern states. Years of county control of roads have left the state with a system composed of unimproved roads and of improved roads having no relation to each other and also with a mess of responsibilities for up-keep and refunding which it is not financially equipped to manage. Change of administration from county to state has not endured long enough to have formulated and harmonized their necessary interrelations and there is a clash of state, regional and county interests which hinders adequate state highway financing. There is a lesson in noting how these conditions have arisen.

Kentucky in 1912 established a State Department of Public Roads with a commissioner as its chief officer. From 1912 to 1914, however, the duties assigned the commissioner were purely advisory to county officials, no funds having been appropriated for state participation in road building and no means being granted to compel adoption of the recommendations made to the county.

In 1914 a forward step was taken. The General Assembly declared the inter-county-seat system of some 8,000 or 10,000 miles to be proposed state highways and created a state road fund out of the license tax received from motor vehicles and a 5c. ad valorem tax on all property. This fund was distributed to the counties each year for road construction under the supervision of the commissioner, in proportion to their assessed valuation, no county receiving more than 2 per cent of the fund. Counties were, however, permitted to anticipate their annual apportionment from the state road by voting bond issues and expending the proceeds under the provisions of the act, reimbursement for the state's share of the cost to be received in future years in annual installments equal to their apportionment of the road fund. The fiscal court of the county was permitted to designate each year any of the inter-county-seat roads for improvement under state aid, and the surveys and plans of the proposed work were made, subject to the approval of both the court and the commissioner.

From 1914 to 1916 the maximum amount that the state road fund received each year did not exceed $750,000 and as the counties put up an equal amount this was all the money available for the construction and reconstruction of 8,000 to 10,000 miles unless a county elected to vote bonds for expenditure under the act, which was done by many counties. Under this law the counties were required to maintain all roads built with state aid. But as there was no penalty for their failing to do so, and as they had but small revenue for such purposes, but little attention by the fiscal courts was paid to this provision. The state aid law continued in force and effect until July 1, 1920, with the exception of minor revisions made by the General Assemblies of 1916 and 1918 relating to the making of surveys and plans by the engineers of the road department instead of those employed by the fiscal courts, and changes in the apportionment whereby the state participated in accordance with the assessed valuation of a county and not on a basis of 50 per cent to each county. Authority was also given to the commissioner to co-operate with the United States in the handling of federal-aid appropriations to the state, pledging the road fund to that purpose with priority over distribution to the counties under state aid.

Though several hundred miles of mediocre roads, disconnected one from the other, were built in the period

between 1914 to 1920, it became apparent that, if the state system of highways connecting all county-seat towns was ever to be constructed, the mileage embraced in the inter-county-seat system must be materially reduced and its construction and maintenance be placed under the direction of the state highway department, with the responsibility fixed. During this time it has been conclusively shown that as long as the initiative in state road construction and maintenance was left in the hands of the average fiscal court, with the right to perform such work with the county forces regardless of plans and specifications, just so long would state

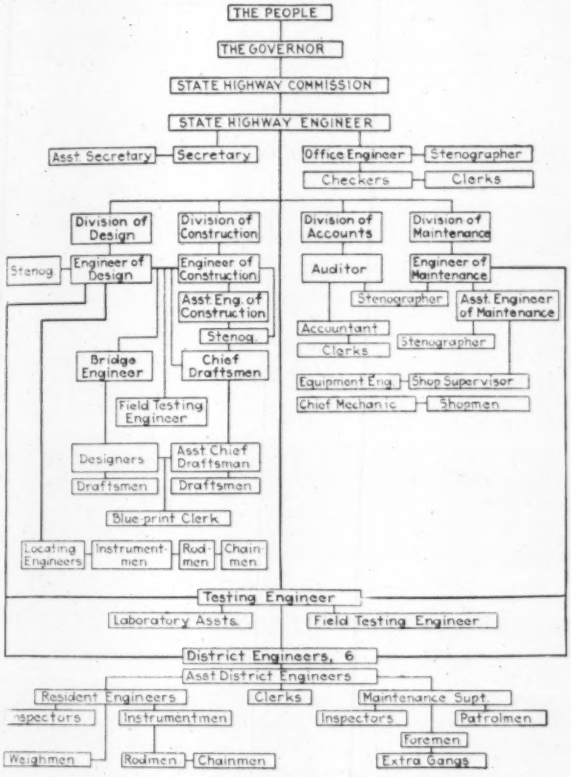


FIG. 6—KENTUCKY HIGHWAY COMMISSION ORGANIZATION CHART

funds be unwisely expended and a poor type of construction obtained.

The General Assembly of 1920, realizing the facts, abolished the state aid law, save for the completion of such contracts as were under way prior to July 1, and enacted in its place the present law, under which the Department of State Roads and Highways, as it is now known, is operating. They declared approximately four thousand miles of the inter-county-seat system to be proposed primary state highways and limited the expenditure of state and federal-aid funds to this system. The administration of the department was placed under the direction of a bi-partisan state highway commission which has developed the organization shown by the chart Fig. 6.

The legacy left the new organization by the preceding eight years of county direction was:

1. A large refunding debt: The operation of the state aid law, by which counties were permitted to vote bond issues, created a debt that will amount to $500,000 per annum for the next four or five years, which debt the department is obligated to pay each year out of its revenues.

2. A large maintenance charge: In the proposed primary system of state highways 862 miles were constructed under the provisions of the former state aid law, and the state highway commission is required to maintain such parts of this 862 miles as meet the requirements of a state highway or that have been brought up to those requirements by the counties.

Handicapped by the old state-aid obligations and by the requirement of the law of 1920 that construction must be simultaneous from 54 construction centers, these conditions exist:

1. The state is building and maintaining patches of road here and there without any considerable length of continuous road anywhere.

2. It is impossible with the available funds to construct within a reasonable time a connected system of inter-county and trans-state roads.

It is proposed to meet the financial requirements by a bond issue of $50,000,000 at the rate of $10,000,000 a year. Legislation providing for a referendum vote on this bond issue failed at the last session of the legislature apparently because (1) the size of the debt was frightening to the people who were accustomed to thinking in county units; (2) the fear was general that increased taxes would be imposed; (3) there was regional and county jealousy. In brief the people had not been educated to think of highways in the modern terms of quantity production and correlated state systems. This task of educating the public prior to the next legislative assembly is the work primarily before those who are promoting road improvement in Kentucky.

Tennessee

Learning Finance and Administration

Tennessee like Kentucky lacks money for highway system development. Roads are being built, many of them are of high type, but they are disconnected. The state has no continuous inter-county routes of significance, nor is it working effectively toward them or toward trans-state lines. Continuity of direction and policies in highway affairs has been interrupted by a changed state administration. Determined official thought is not evident and popular thought is unformed. Definite policies of finance and development are indicated only in the bond promotion plans of the Tennessee Good Roads Association.

County co-operation is the theory of state road development in Tennessee. An act of 1913 amended in 1919 enabled counties to raise bonds for highway purposes. The counties have been prompt to take advantage of this privilege. In 1922 the 70 counties of Tennessee had voted bonds for road building to the amount of $34,365,000. Of the total voted, $27,780,500 have been issued and the par value of the bonds sold is $27,345,000. The amount authorized but not issued totals $6,585,000. Of the bonds issued $4,487,000 were for federal and state-aid projects, while the counties themselves issued $22,933,500 for the construction of local roads. Primarily to meet federal-aid a one-mill property tax was assessed in 1919, all funds in excess of the amount of federal-aid to go to the counties for expenditure on state roads. In 1919 was passed the bill establishing a state highway department and creating a road fund by establishing license fees on automobiles,

provided that half of the money shall go to the counties for state roads.

Participation of counties in the administration of state roads exhibits the usual results—a fair mileage of isolated improvements often of high type, but little continuous route development. All funds for state roads including federal-aid allotments amount to between three and four million dollars a year. This fund promises very slow system development and the prospect is unsatisfactory to a large faction which, directed by the Tennessee Good Roads Association, is demanding more active development. In furtherance of their demand they are asking for a bond issue.

At the session of the Legislature for 1922-23, a bill was introduced which provided for a referendum on a bond issue of $75,000,000, to be sold at a rate not to exceed $10,000,000 a year, and on a method of financing these bonds. By the law all income from auotmobile license fees, from a 2c. gasoline tax and from a ½-mill property tax was to go to the state highway department "to be used exclusively for retiring the bonds with interest and to build and maintain the state system of highways." This bill failed to pass. The Legislature did, however, enact a law imposing a 2c. gasoline tax. The influences worked for the failure of the bond referendum act. One was the large figure set; a sum of the size named was staggering in the light of previous expenditures. The second influence and perhaps the stronger, was the disinclination of the counties to relinguish all part in the administration of state highways. Even the provision of the act for refunding county bond money spent on state roads did not overcome this county opposition.

The fight for a bond issue is being continued by a campaign of public education: (1) to make clear the necessity of large expenditure, and (2) to overcome the prejudice for county management of funds for state roads in the county. There is a demand for roads. Already state aid has been asked by counties on 2,500 miles estimated to cost over $62,500,000. With the financing plan made clear and the argument for state direction forcefully presented it is a fair presumption that enabling legislature will come.

A contributing complication to the situation is the change in the direction of the highway department. Tennessee like 13 other states, put its state highway affairs under new management during the past winter. The new management has scarcely aligned itself for its work.

[*In the final article of the series, the highway situation in Missouri will be discussed.*]

Essington Channel Deepens Itself

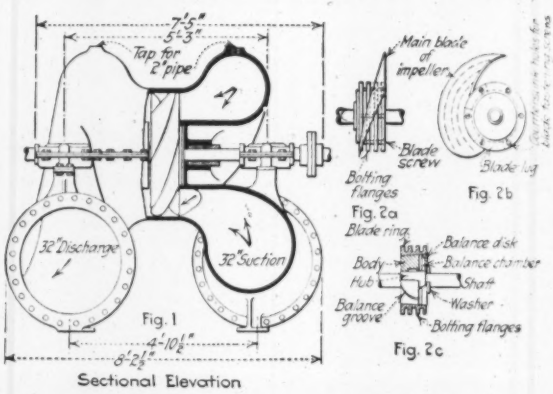
Manufacturers on the Essington Channel of the Delaware River are much aggrieved because of the failure of the Government to dredge the channel. During the war permission was given the Shipping Board to partially obstruct the channel in the course of its improvement of the Hog Island ship yard. The Shipping Board in turn agreed to keep Essington Channel dredged. In disposing of the ship yard, the purchaser was relieved of the dredging obligation. The manufacturers who use the channel contend that it is the obligation of the War Department to maintain the channel. The District engineer at Philadelphia has reported that the channel is scouring out of itself. He does not think the navigation requirements justify dredging.

New Type of Low Lift Pump Called Rotary Flow

Drainage and Irrigation Pump—Axial Flow Type—Steadily Increasing Delivery—Wide Variation of Speeds

By Eugene F. Delery
Design Engineer, Sewerage and Water Board, New Orleans, La.

A NEW TYPE of pump, of value as a drainage and irrigation pump for lowhead work, was invented, patented, and built by the author in 1915 and has given very satisfactory results after several years of testing. It is of the axial flow, or screw, type and its outstanding features are: (1) The use of a suction volute to conduct the fluid to the impeller with a constant tangential component of velocity as well as a constant axial component of velocity and its discharge in like manner by means of a discharge volute, both volutes registering with the impeller in an axial rather than a radial direction. This makes possible the use of a higher speed



FIGS. 1 AND 2—DETAILS OF ROTARY FLOW PUMP
Six-blade impeller, blade mounting and balance device. One blade in position.

than is usual, without cavitation, and also makes it feasible to secure a correct entrance blade angle at all points and equal radius at the entrance to the impeller. This is not possible with the ordinary type of entrance elbow, due to the variation in velocity at the inner and outer radii of the elbow. (2) The impeller is hydraulically balanced by means of an integrating hydraulic balance consisting essentially of a set of secondary blades formed by grooves cut on the drum of the main impeller and by the blade ring carrying the main impeller blades. These secondary blades, which are reversed in pitch, as regards the main impeller blades, take a small percentage of the fluid pumped to the discharge passage, immediately beyond the impeller, at the discharge passage pressure and discharge it at a higher pressure to a normally closed pressure chamber within the impeller. This chamber is formed between the inner surface of the main blade ring and a free floating disc fitting closely within the blade ring and placed on the shaft in such manner that the fluid within the chamber reacts against the impeller body and the disc which in turn reacts against the suction face of the casing but is not attached to either the blade ring or the shaft in any manner. These secondary blades are so pitched that the pressure in the balance chamber is inversely proportional to that existing in the discharge passage as the areas of the disc is to the area of the discharge

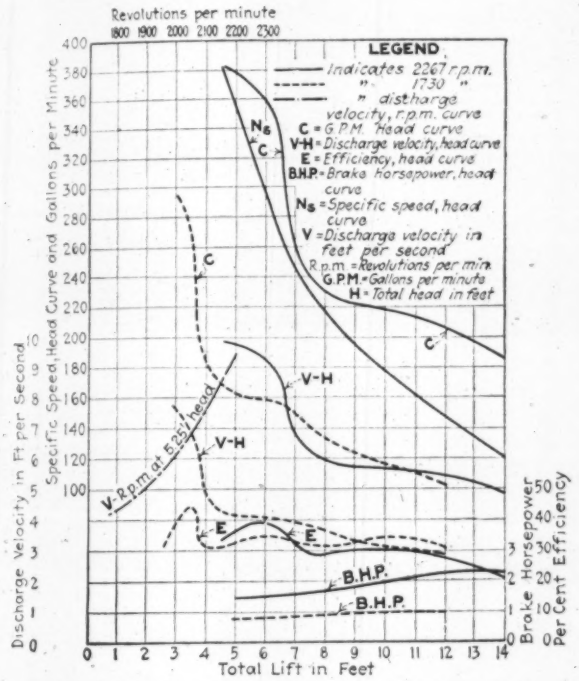

Revolutions per minute
1800 1900 2000 2100 2200 2300
LEGEND
Indicates 2267 r.p.m.
" 1730 "
" discharge velocity, r.p.m. curve
C = G.P.M. Head curve
V-H = Discharge velocity, head curve
E = Efficiency, head curve
B.H.P. = Brake Horsepower, head curve
Ns = Specific speed, head curve
V = Discharge velocity in feet per second
R.p.m. = Revolutions per min.
G.P.M. = Gallons per minute
H = Total head in feet
Discharge Velocity in Ft. per Second
Specific Speed, Head Curve and Gallons per Minute
Brake Horsepower
Per Cent Efficiency
Total Lift in Feet
V-H
E
B.H.P.

FIG. 3—TEST CURVES—4-IN. ROTARY FLOW PUMP

face of the impeller. As this ratio is a constant the device operates equally well at all lifts.

Provision is made whereby a small amount of fluid is allowed to pass through the balance disc by means of a small aperture to a recess next the suction stuffing box, thus furnishing high-pressure fluid as a seal at that point. Anyone who runs low-lift pumps will readily concede that this is a desirable result.

The blades are detachable, but are fastened in a manner which makes them easily removable for any purpose. This allows a large variation of pitch and speeds, making it possible to standardize one casing for a large range of capacities, heads, and speeds. The method of fastening consists essentially in first cutting a series of parallel circumferential grooves on the blade ring (or in its absence the hub). On each blade there are cast as many lugs as there are grooves on the blade ring. These lugs are set in advance of each other in such manner that lugs of adjacent blades superpose each other. The fastening bolts, set parallel to the shaft, each fasten in double shear one lug each of as many blades as there are grooves. Ordinarily there will be only as many bolts as there are blades, and all blades are independently removable with ease. As diffusion (directing) vanes are not necessary they are omitted, thus making for better general efficiency and reducing the liability of choking to a minimum. Smoothness of operation and balance are thus assured, as all blades are cast from the same pattern.

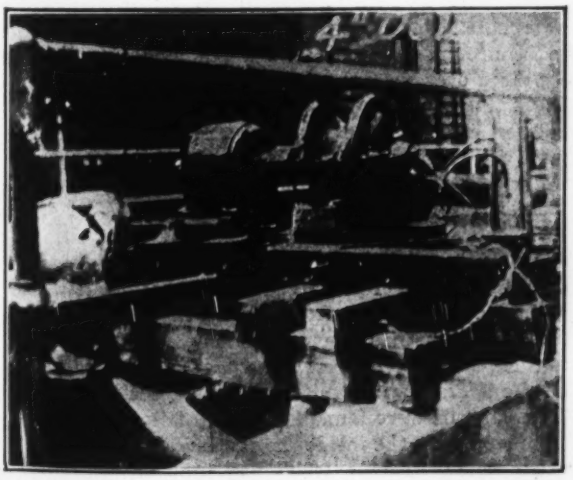


FIG. 4—MODEL PUMP USED IN MAKING TESTS

A study of Figs. 1, 2a, 2b, 2c, will readily bring out the above. Fig. 3 is a chart showing the results of tests run on the 4-in. test pump shown in Fig. 4. The tests conducted according to standard rules for testing show, when size, lift, and capacity are considered, a broad variation of speeds, a steadily increasing delivery for increasing speed and constant lift; a high specific speed; a large increase of delivery at the very low lifts, with well sustained delivery over the whole range of lifts. On the very low lifts, up to the point of design, the efficiency is very high for a pump of its size under the operating conditions, and the efficiency is well sustained at all other lifts, giving a high average efficiency. The brake horsepower curves show a very constant power demand over the whole range of lifts, and as in order to get maximum plant efficiency it is desirable to have the prime mover always operate as near as possible to its best rating this is a very desirable feature. The efficiencies shown compare more than favorably with the efficiencies of the best types of other pumps of equal size operating at equal capacities and against equal heads, for which it has been possible for the author to secure records.

Tennessee Power Developments

Application for a preliminary power permit covering three large projects on the Clinch and Powell Rivers, part of the upper Tennessee River system, has been filed with the Federal Power Commission by the Tennessee Electric Power Co. Applications covering almost the identical sites covered by this application have already been filed by the Knoxville Power & Light Co., a subsidiary of the Electric Bond & Share Co., and by the Tennessee Hydro-Electric Co. One of the three proposed developments is on the Clinch River below its junction with the Powell. The plan calls for the erection of a plant with a 175-ft. head and a dam which will create a storage reservoir 72 miles long. A 40-ft. draft on this reservoir will make 1,000,000 acre-ft. of storage available for stream control purposes, an amount which will equalize the flow of the river and make it possible to develop 100,000 continuous horsepower at this site. The second development is at the upper end of the pool of the first development near the Cheat River station, with a head of 160 ft. and an output of 50,000 hp. The third development is to be on the Powell River near the town of Combs. It will have a head of 180 ft. and an output of 27,000 hp., making a total of 177,000 hp. for the three sites. The Tennessee Electric Power Co. has a present installation of 108,000 hp. in hydro-electric plants at Hales Bar on the Tennessee, another on the Ocoee, and another at Great Falls on Taney Fork. In addition it has three steam plants with a capacity of 59,000 hp. The company reports that its load is growing at such a rate that it will require 40,000 more horsepower within the next four years.

From Job and Office

Hints That Cut Cost and Time For the Contractor and the Engineer

Rule for Computing Angle-Bar Weights

By Paul C. Trimmer
St. Paul, Minn.

IT IS OFTEN necessary to determine the weight per lineal foot of an angle bar when only the thickness and flange dimensions are known, and also the thickness of any given angle knowing only the weight per lineal foot and flange dimensions. Men to whom the billing, stocking and handling of steel from stock are intrusted are, many times, unacquainted with the steel handbook. It is to them that the following method may be of good use.

If one cubic foot of steel is assumed to weigh 489.6 lb., then a square foot (12 in. x 12 in.) 1 in. thick weighs 40.8 lb., and a strip 12 in. long, 1 in. wide and 1 in. thick weighs $\frac{40.8}{12}$ or 3.4 lb. A strip 12 in. long, 1 in. wide and $\frac{1}{32}$ in. thick is equal to $\frac{3.4}{32}$ lb. or 0.10625 lb. or 0.1 lb., say. It can be seen from the foregoing that a strip of metal 12 in. long and 1 in. wide has $\frac{1}{32}$ of an inch in thickness for every $\frac{1}{10}$ of a pound in weight.

Example: 12 in. of a certain 3x3 angle weighs 7.2 lb. per lineal foot. The sum of the flanges is 6 in. If 6 in. = 7.2 lb., and 1 in. of this particular thickness weighs $\frac{7.2}{6}$ or 1.2 lb., or $\frac{12}{10}$ lb.; and if $\frac{1}{10}$ lb. is $\frac{1}{32}$ in. thick, $\frac{12}{10}$ lb. is equal to $\frac{12}{32}$ or $\frac{3}{8}$ in., which is the thickness required.

Rules: $\frac{\text{Weight per foot} \times 10}{\text{Sum of Flanges}} =$ the number of thirty-seconds in thickness; also the number of thirty-seconds $\times$ sum of flanges $= \frac{\text{weight per foot}}{10}$

These simple rules may easily be memorized by anyone and computed mentally.

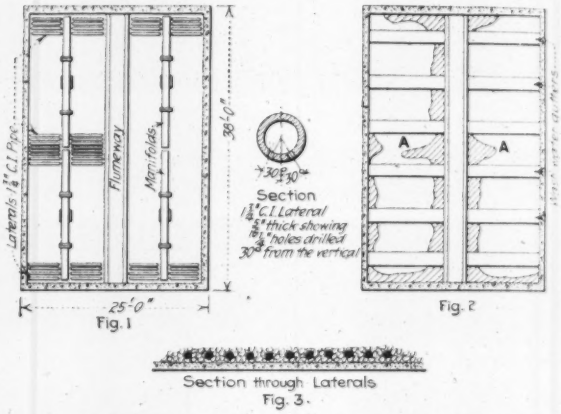
Successful Means of Removing Hard Spots From Filter Beds

By W. Compton Wills
Assistant Engineer of Distribution, Water Department, Wilmington, Delaware

UNDER-DRAINAGE difficulties in the operation of mechanical filters often give the water-works engineer considerable difficulty. The means by which these difficulties may be overcome are well demonstrated in the experience of the writer at the Wilmington plant. Soon after the plant was put in operation in 1917, "hard spots" appeared in the filter sand. The size of the spots increased until about one-third of the filtering area was affected. Various methods of removing the spots were tried, such as increasing the vertical rise of the wash water, ejecting water pressure by perforated pipe, and ejecting water pressure through hose into the hard areas. In some instances, even, the hard portions of the filtering area were dug out. All such means proved only temporary, so the conclusion was reached that the faulty wash was caused by some undiscovered condition existing in the under-drain or strainer system of the beds.

In the latter part of 1920 permission was granted to tear out and thoroughly examine the sand, gravel, and strainer system of a filter bed. After such an examination methods were devised to overcome the faulty wash. Early in 1921 this filter bed was turned back into service and up to the present time it has been free from hard spots and has remained level over its entire filtering surface.

The strainer system of these beds as shown by Fig. 1, consists of four 6-in. x 9-in. cast-iron manifolds, two placed end to end and running longitudinally and spaced



UNDER-DRAINAGE SYSTEM OF FILTER PLANT

one-half way between the side of the filter and the flumeway shown in the center of the bed. Leaded into these manifolds are 1¾-in. cast-iron laterals on 6-in. centers and drilled every 6 in. of length with two holes, ½ in. in diameter, facing downward at an angle of 30 deg. from the vertical. The center line of each lateral is 3 in. from the filter floor.

The hard spots appeared in the locations and approximate shapes shown by Fig. 2. The trouble seemed to be around the walls and a particularly bad place appeared over the ends of the manifolds (Section A-A, Fig. 2).

Upon removing the sand and gravel muddy deposits were found that had not been removed by the wash water. Upon inspecting the laterals, it was discovered that in several instances the large gravel (for which specifications called for a layer 9 in. thick of such size as would pass a 2½-in. circular opening and be retained on a sieve with 1-in. circular openings) had become wedged against the laterals and cemented over the ½-in. holes, and thus had stopped the flow of the wash water to this portion of the bed. The next step was to remove all the laterals and manifolds. In the ends of some of these laterals were found debris and laitance, so located as to stop from the inside the proper distribution of the wash water. The material had probably gotten into the system during construction, when because of war-

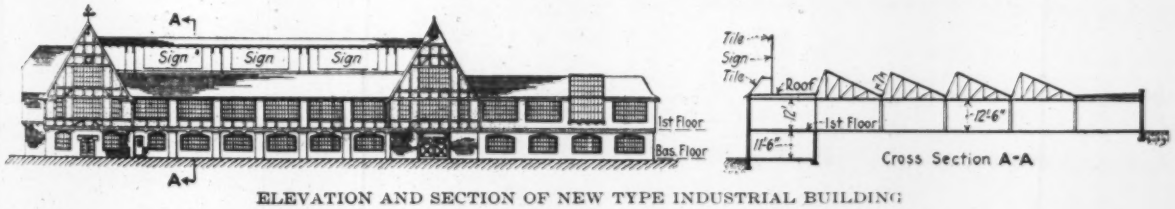
time conditions proper selection and supervision of labor was difficult.

The conclusion at this point was drawn from our findings that the small ¼-in. holes of the laterals were not free enough to deliver, and the voids of the coarse gravel not open enough to allow a sufficient quantity of wash water to be collected above the entire strainer system before it was forced on its vertical rise. In correcting this condition the laterals were dipped in a preparation which would not give taste to the water and were replaced into the manifold. About these laterals and manifolds were placed blue granite stone screen tailings. The tailings selected were mostly laminated stone varying in size from 2 in. x 4 in. x ¾ in. to 5 in. x 6 in. x 2 in., and having all shapes. Spaces beneath the laterals were left entirely open, the laminated stones forming side walls along the laterals. Enough tailings were placed over the laterals to cover the pipes and any large voids between the heavy stones. Next, the old courses of gravel were replaced, followed by the filtering sand.

This filter has been in continuous operation since the first part of 1921 and the sand remains perfectly level at the present time. This bed has a sand area of 735 sq.ft. The washing is done by high velocity wash-water, without air or mechanical agitation. A vertical rise of wash-water equal to 27 in. is being used on this filter bed and the difficulties previously experienced in washing have entirely disappeared.

Craftsman Type Architecture for Industrial Buildings

ENGINEERS who are concerned with the development of architectural details in industrial buildings will be interested in the new plant which is being built for the Latham Litho & Printing Co. at Long Island City. For a manufacturing plant this building presents a novel appearance. It is not the idea of the Latham company to disguise the fact that they are using the plant for manufacturing, but rather to express the individuality of their business. They believe that this craftsman type of architecture accomplishes their purposes, and although the two facades shown in the sketch give the building an impractical appearance for a manufacturing plant the cross-section in the accompanying sketch shows that its saw-toothed roof provides a very practical floor layout.



ELEVATION AND SECTION OF NEW TYPE INDUSTRIAL BUILDING

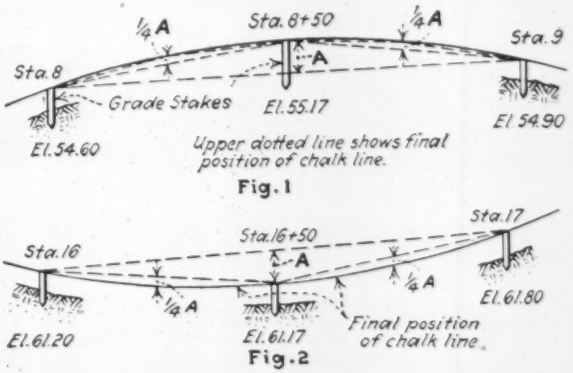
The building will have a floor space of about 60,000 sq.ft. which includes lounging and lunch rooms for the employees and a garage for trucks and employees' automobiles. It will be set back about 70 ft. from the building line and this area, together with the rest of the land surrounding the property, will be laid out in an attractive park. The first story will be built of tapestry brick, the upper story of half timber and stucco, and the roof will be green shingle tile. The windows will be of steel sash of the cottage casement type. The saw-toothed roof will be covered with a standard tar and gravel roofing. As the face of the building is along the elevated tracks of the Long Island R.R., the gable will be provided with three spaces for standard bill posters where the Latham company will display copies of the posters which they print in their plant.

Walter Kidde & Co., Inc., are the architects and engineers, as well as the builders of this plant, and have engaged McDonnell & Peare of New York to design the facades.

Setting Forms on Vertical Curves for Concrete Paving

By Ray E. Behrens
County Highway Engineer, Waukesha County, Waukesha, Wis.

REGARDLESS of the nicety of the finish on a concrete road it will not possess desirable riding qualities unless the form setting is good. Little trouble is experienced in getting a satisfactory job on tangents and on straight grades. But vertical and horizontal curves frequently present difficulties to the form setter, as is evidenced by many completed jobs in which practically all curves, horizontal as well as vertical, consist of a series of angle points joined by chords. This is especially true of vertical curves, where poor form setting is not so noticeable to the eye, but where it is however, decidedly deficient in riding qualities.



METHOD OF FORM SETTING ON VERTICAL CURVES

On tangents and on straight grades stakes should be set with a transit every hundred feet to line and to grade. Intermediate stakes can be set with sufficient accuracy by means of Swedish T-stakes. Where vertical curves are circular and not parabolic, the following method has been found extremely practical and simple of application. When correctly applied perfect vertical curves will result.

On vertical curves stakes should be set to grade every 50 ft. with an instrument. The form setter then determines by means of his T-stakes and an ordinary rule,

how much the 50-ft. stake is above or below the two adjacent 100-ft. stakes (regular stations), depending upon whether the curve is a "crest" or a "sag."

Fig. 1 represents a "crest." Here the form setter will "T" between Sta. 8 and 9 showing that the grade stake at Sta. 8 + 50 is 5 in. above a straight line from Sta. 8 to Sta. 9. Call this distance "A." He will then stretch a chalk line tightly to grade between Sta. 8 + 00, 8 + 50 and 9 + 00. At the 25-ft. points, i.e., at Sta. 8 + 25 and 8 + 75 he will set auxiliary grade stakes, the grade points of which will be ½ of "A" or 1¼ in. above the chalk line. Raising the chalk line to the grade points at the 25-ft. stakes will reveal the outline of the vertical curve. However, his final step will be to raise his forms by ¼ of 1¼ in. or ⅝ in. above the chalk line at each 12½-ft. point. If the engineer or the inspector on the job will furnish the form setter with the value of the distance "A" it will save him the operation of "T"ing between the station stakes. "A" can readily be computed from the plan elevations.

Fig. 2 represents a "sag" or a "trough." Here, again, stakes are set to grade by instrument at Sta. 16 + 00, 16 + 50 and 17 + 00. The form setter by the use of his T-stakes has determined that Sta. 16 + 50 is 4 in. ("A") below a straight line from Sta. 16 + 00 to Sta. 17 + 00. After stretching his chalk line tightly from Sta. 16 + 00 to 16 + 50 and from 16 + 50 to 17 + 00, he allows it to drop or sag by an amount equal to ½ "A" or 1 in. at the 25-ft. point. The chalk line will then show a perfect vertical curve, and the forms can be set directly to the line.

The above method of measuring mid-ordinates can be used equally well on horiztonal curves.

When once thoroughly explained and *demonstrated* to a form setter, the latter will pride himself with possessing a "system" and better form setting will result.

Ford Engine Used to Operate Headgates

By William Arthur
U. S. Indian Service, St. Xavier, Mont.

At the Big Horn Headgate, at St. Xavier, Mont., there are five gates, each weighing two tons. When they were geared to a hand wheel to raise and lower them, it required 64 turns of the wheel to move a gate one inch. This was a slow process; in fact the 64 to 1 ratio proved too slow in cases of emergency. The average water pressure is 11 ft., low water 17 ft. and high water 16 ft.

A Ford engine has been used to move the gates, as shown in the accompanying illustrations. The engine was geared to the hand wheel, with eight control levers, one of which slides the fork clutch into the perpendicular hand wheel, another controls the brake for clutch or speed, a third is the reverse to lower the gates, a fourth is high and low to raise the gates, and the others are for car brake to hold the car in position while in operation, carburetor control, spark control, and transmission lever to move the car to the next gate or to the shed.

The engine runs on tracks with a 6 ft. 1½-in. gage, and about 60 ft. of track suffice for the operation of the five gates.

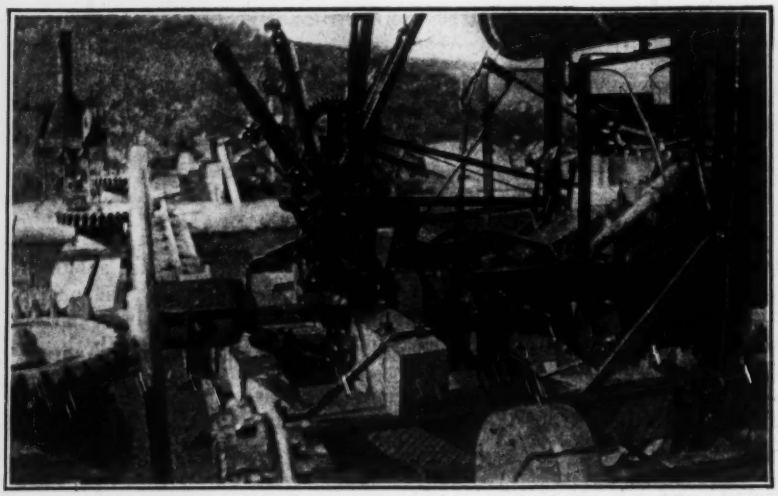
From Job and Office

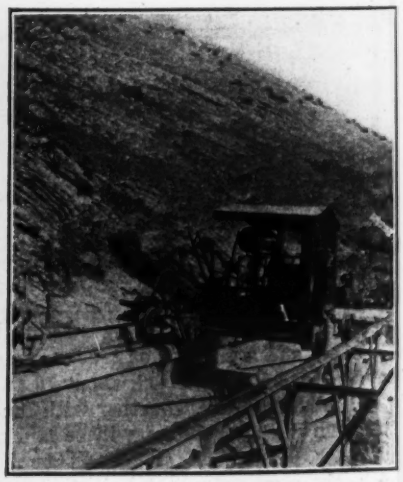
Hints that Cut Cost and Time

"Hump Switch Yard" for Power House Construction Job

Construction of power house No. 3 on the Big Creek project of the Southern California Edison Co. involved the excavation of a large amount of loose material from power house and penstock site. This material, added to a natural gravel bar at a bend in the river, made a practically level area several acres in extent, immediately adjoining the power house site. By dumping the material so as to leave the surface with an easy grade inclining upward toward a steam donkey engine in one corner of the area it was possible to lay out a material storage yard in which distribution of loaded cars was made without the use of a switching locomotive.

The accompanying illustration shows the arrangement of the material yard into which cars come from the main line railroad down a long steep incline onto the track in the foreground. Here they are left for





FORD ENGINE, MOUNTED AND RUNNING ON TRACK, GEARED TO HAND WHEEL CONTROLS GATES
At left, forked clutch in mesh to hand wheel to raise and lower gates. At right, headgate built 27 years ago out of native rock

From Job and Office

For Contractor and Engineer

distribution with the aid of only the steam donkey engine at *A*.

A cable from this engine first draws the car above any desired switch after which the switch is thrown, the car is released and, by means of its brakes, is stopped at the desired point. Reinforcing steel, lumber of various classifications, wood stave pipe, and other materials were delivered in this way.

GRAVITY SWITCH SYSTEM IN MATERIAL YARD

The same steam engine delivered crushed rock from the bunkers in the left foreground to the concrete mixers at the power house which is to the right beyond the limits of the picture. To accomplish this two pulls were necessary; the dump cars were first pulled up the incline from the bunkers, allowed to drop then by gravity to a position behind the warehouse at the right of the picture whence by means of a snatch block and return line the cars were hoisted up an incline to bunkers over the mixer.

Highway Bridge Built of Railroad Car Sills and Ties

By Crosby Tappan
Tyrone, Pa.

On THE State Highway between Tyrone and Bellwood, Pa., there was an old covered truss bridge of about 120-ft. span. Last year a colored tourist in a Ford ran into one side of the bridge and knocked it down. As this is a heavily traveled highway the county commissioners of Blair County, who are responsible for the bridge and its maintenance, at once erected a temporary bridge, pending the construction of a new permanent structure. They obtained from the Pennsylvania R.R. twelve old steel car sills and some ties. They built two cribs with the ties, bolting them together and further bracing them with an 8-in. I-beam at each corner. These I-beams were long enough to extend about 3½ ft. above the floor of the bridge; and they carried two lines of steel cable as a guard fence. The cribs were filled with rock.

TEMPORARY BRIDGE MADE FROM RAILROAD MATERIAL

The bridge, as rebuilt, consists of three spans, 37.5 ft. c. to c., with a clear span of 32 ft. The floor is two layers of 3-in. plank, the upper layer being creosoted. The width of the floor is 12 ft. 8 in. between guard rails. To carry the floor and traffic four old car sills were used, spaced 4 ft. 6 in. c. to c. These car sills are 20 in. deep at the center and 12 in. deep at the ends and are braced together with tie-rods.

This bridge demonstrates engineering ability in meeting an emergency and in making use of available local material so as to keep traffic moving.

Determining Regulated-Flow Duration Curves Graphically

By Dr. George E. Lyon
Rensselaer Polytechnic Institute, Troy, N. Y.

THE WRITER believes that the following graphical method for the determination of the regulated-flow duration curve will be of interest.

In the first place the construction of the natural-flow curve will be reviewed. Table I gives the mean monthly flow of a certain stream in second-feet for a period of four years—sufficient to illustrate the problem. The

TABLE I

Year	Month	Mean Monthly Flow Sec.-Ft.	Accumulated Discharge Billion Cu. Ft.
1909	Jan.	675	1.77
	Feb.	1,158	4.81
	Mar.	1,019	7.49
	Apr.	992	10.10
	May	490	11.39
	June	258	12.07
	July	86	12.30
	Aug.	124	12.62
	Sept.	184	13.11
	Oct.	97	13.36
	Nov.	139	13.73
	Dec.	476	14.98
1910	Jan.	963	17.51
	Feb.	953	20.01
	Mar.	727	21.92
	Apr.	1,267	25.25
	May	577	26.77
	June	213	27.38
	July	75	27.58
	Aug.	75	27.77
	Sept.	202	28.30
	Oct.	90	28.54
	Nov.	337	29.42
	Dec.	303	30.22
1911	Jan.	451	31.40
	Feb.	514	32.76
	Mar.	1,108	35.67
	Apr.	649	37.37
	May	439	38.53
	June	374	39.51
	July	139	39.88
	Aug.	225	40.47
	Sept.	184	40.95
	Oct.	394	41.98
	Nov.	157	42.40
	Dec.	510	43.74
1912	Jan.	366	44.70
	Feb.	600	46.28
	Mar.	1,430	50.03
	Apr.	1,106	52.94
	May	713	54.81
	June	168	55.26
	July	139	55.62
	Aug.	150	56.01
	Sept.	154	56.42
	Oct.	255	57.09
	Nov.	225	57.68
	Dec.	480	58.94

lowest value in the table (75 sec.-ft.) is plotted at 100 per cent time (Fig. 1), the second lowest value (also 75 sec.-ft.) is plotted at 97.9 per cent (= 47/48 expressed as a per cent), the third lowest opposite 46/48 (in per cent) etc., there being 48 months during the period under consideration. Any point on the curve will show the per cent of time during which the flow

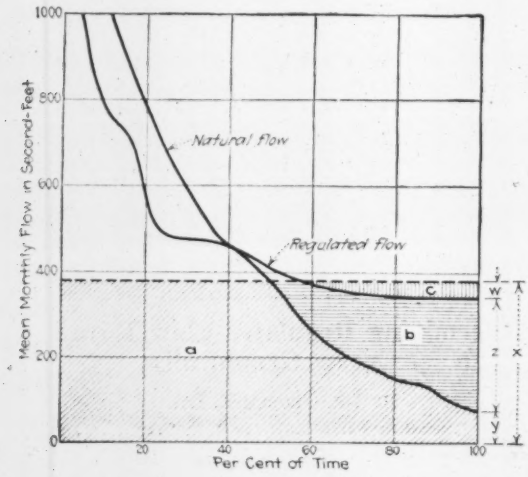


FIG. 1—DURATION CURVES FOR STREAM FLOW

has been "equal to or greater than" the value of the ordinate at that point.

For the construction of the regulated-flow line, the mass diagram must first be plotted; accumulative discharge in cubic feet vs. time in months. The ordinates for the diagram are given in the last column of Table I, each value representing the total number of cubic feet which has passed the point on the stream under consideration from the time the table was started up to and including the month opposite which this ordinate is plotted. The mass diagram is shown plotted in Fig. 2.

Suppose now that we are to construct the regulated-flow duration curve due to a storage reservoir of 3,000,000,000 cu.ft. capacity. Choose the first "summit" *A* on the diagram as the starting point and lay off the ordinate *AB* equal to the capacity of the reservoir to scale. Draw the line *BC* tangent to the next "valley" (at *C*) on the diagram, producing it to *D*, at which point the ordinate *DE* = *AB*. The slope of the line *BD* indicates the rate at which water may be discharged, starting with a full reservoir at *B*, just emptying it at *C* and having it full again at *D*. Repeat this construction at *A'B'C'D'E'*, *A"B"C"D"E"*, etc. To complete the regulated flow lines by joining *D* and *B'*, *D'* and *B"*, etc., any combination of lines may be used, remembering that the greatest ordinate between the natural- and regulated-flow lines must not exceed the capacity of the reservoir. It will be seen that the ordinate between these two lines at any time is equal to the volume of water in the reservoir at that time.

To get the data from the regulated-flow lines in Fig. 2 for plotting the regulated-flow duration curve (Fig. 1) the time for each different rate may be measured in inches and the rate of discharge by the slope of the line. In the case at hand the horizontal scale used was 1 in. = 2 months; hence the total length of time (four years) may be expressed as 24 in. From this, Table II may be computed. The first column gives the regulated flow in second-feet, arranged in order of magnitude, and the second column the time in inches during which that rate occurred. Column three is found in the same manner as were the per cent times used in plotting the natural-flow duration curve. The first value (100 per cent) shows that for 100 per cent time the regulated flow would be "equal to or greater than" 340 sec.-ft. The second value (79.2 per cent) equals $\frac{24 - 4.3}{24}$, expressed in per cent, since the flow would be equal to or greater than 348 sec.-ft. except for 4.30 in. of time, etc. Having completed Table II, the regulated-flow duration curve may be drawn as shown in Fig. 1.

TABLE II

Regulated Flow Sec.-Ft.	Time In.	Per Cent Time
340	4.30	100.0
348	5.13	79.2
372	3.50	60.6
434	5.25	46.1
490	0.50	24.3
544	0.62	22.2
580	0.50	19.6
685	2.00	17.5
781	0.70	9.2
910	1.00	6.2
1,270	0.50	2.1
	Σ = 24.00	

In connection with water-power investigations, if the

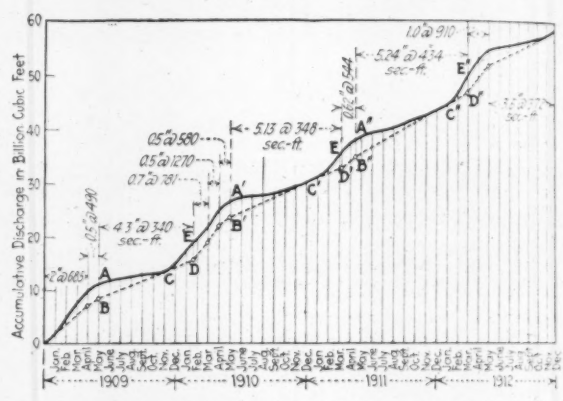


FIG. 2—MASS DIAGRAM FOR STREAM FLOW

head is constant, ordinates in Fig. 1 are proportional to power and areas are proportional to energy. Suppose for instance that a capacity of *X hp.* is considered. Without regulation the water station can develop *Y hp.* at its driest period. Due to regulation, *Z hp.* more can be added at low water. If the *X hp.* is to be continuous, the maximum capacity of an auxiliary station should be *W hp.* The area *a* represents the kilowatt-hours output of the water station without storage, area *b* the output added by regulation and area *c* the output supplied by the auxiliary station. These areas may be measured in kilowatt-hours per year, in which case the values would be the average yearly outputs over the same length of time as used for the construction of the duration curves. From the figure it will be seen that the auxiliary plant is operated on an average of 41 per cent time or 150 days per year.

From Job and Office

Hints that Cut Cost and Time

Dredging Started for Vancouver Dry Docks

Extensive dredging operations required to provide sufficient depth for the operation of the new floating dry docks at North Vancouver are now well under way; the dredging and filling will take about four months and cost $400,000.

From Job and Office

For Contractor and Engineer

Device for Counting and Weighing Traffic on Roads

WEIGHTS and number of vehicles passing over a highway are automatically recorded by a new device employed in the traffic studies now being made on the Washington-Baltimore road by the Bureau of Public Roads and the University of Maryland. As indicated by Fig. 1, the apparatus consists of a rubber hose, filled

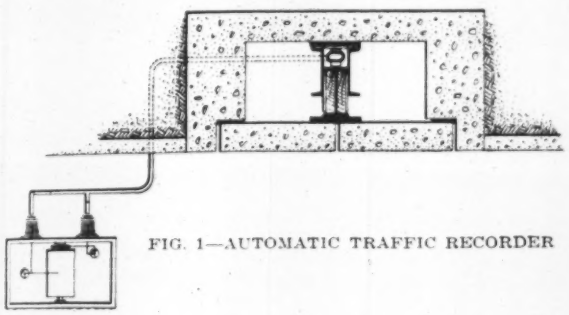


FIG. 1—AUTOMATIC TRAFFIC RECORDER

with water, which is placed beneath the pavement in such a way that the weight of a vehicle passing over it is transmitted to it. A small tube runs from the hose to a standard pressure recording device. A passing vehicle compresses the water in the hose and the pressure is transmitted through the tube to the recording device. There the pressure actuates a lever which makes a record, Fig. 2, on a cylindrical roll of paper and also actuates an attachment for moving the paper to receive a fresh record.

Two sets of apparatus will ordinarily be used, one for the traffic in each direction, and possibly a slight ob-

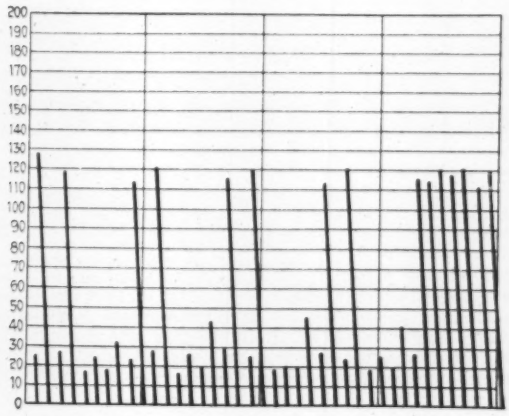


FIG. 2—TRAFFIC RECORD WITH TEST VEHICLE

struction may be placed in the center of the road to confine the traffic to proper lanes.

The instrument may be calibrated by driving vehicles of known weight over the place where the hose is installed and noting the height of line made on the record paper.

A record covering any desired period of time will show the weight of both front and rear wheels of all vehicles which have passed over the road. Should it be desired the apparatus can be further improved so as to show the time at which the vehicle passes.

Powder Magazine Made From Old Steel Tunnel Forms

IN BUILDING powder houses on the Big Creek project, the Southern California Edison Co. in two instances made use of steel tunnel forms brought to this work after they had served their purpose on another part of the system. These forms consist of steel plates, 2 ft. square, arranged to be set up in parallel rows supported on a steel frame and with internal means of holding inside and outside walls 2 ft. apart.

The powder house shown in the accompanying illustration is 20x60 ft. in plan, inside, and has walls 10 ft. high. The roof is supported on three rows of posts, one row inside each of the side walls and one down the center of the building. The walls were filled with earth

POWDER HOUSE MADE OF OLD STEEL TUNNEL FORMS

and a layer of earth was also placed in the roof, i.e., supported on planks and filling the space between purlins and rafters. The roofing proper consists of corrugated iron.

Powder houses built in this way have been found to be more satisfactory than those built under ground, which are very damp in wet weather.

Cutting Concrete Piles with Dynamite

IN BUILDING a reinforced-concrete wharf at the Pearl Harbor Naval Station, Hawaii, penetration of concrete piling was such that in many cases the refusal point was reached as much as 7 ft. above the desired grade. Lieut.-Commander S. Gordon, Civil Engineer Corps, U. S. Navy, devised a system of dynamiting the piles, says a recent issue of *Explosives Engineer*, which was an adaptation of means previously used on wooden piles.

After exploding a stick of 60 per cent dynamite in a 1-in. horizontal hole cored at the butt of a test pile, the shattered concrete was cut away, the surface smoothed with carborundum, tests for cleavage made on the concrete with magnifying glass and hammer, and the reinforcing bars subjected to bending tests. As both concrete and rods were found undamaged, holes were then cored around the butts of the remaining piles, which were shot in batteries of eight. In no case did the disruptive damage extend farther than 18 in. from the center of the charge.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Another Co-operative School

Sir—Under date of June 14, 1923, p. 1050, you published an article on "Developments in Co-operative Engineering Courses," by Dean R. L. Sackett of Pennsylvania State College.

In the article, he describes the plans in effect at the University of Cincinnati, Massachusetts Institute of Technology, Harvard University, New York University, and Antioch College. No mention is made of the School of Engineering, Northeastern University, although the co-operative plan was established here in 1909 and we will have during the coming year approximately one thousand students in the School of Engineering. The school is a recognized school of college grade offering curriculums in civil, mechanical, electrical, and chemical engineering, and awarding the bachelor's degree.

CARL S. ELL,
Dean, School of Engineering,
Northeastern University.

Boston, Mass.,
July 24, 1923.

Unification of St. Louis Terminals

Sir—In mentioning my talk on the St. Louis freight terminal situation in your report of the American Society of Civil Engineers' convention at Chicago you state that I advocated "improvement and ultimate unit operation" of the freight terminal facilities. This gives a wrong impression, in that it appears to imply my advocacy of operation of all these facilities by a single agency. I believe thoroughly in the consolidation of the classification and transfer of cars interchanged between railroads, but such consolidation need not be performed by a single agency. In fact, there is no reason why it should not be performed by several agencies. I believe that the complete unit operation of railroad terminals in large cities served by many railroads is unsound, and I do not want to be known as advocating unit operation.

It is true that the St. Louis committee on terminal improvements, of which I am a member, recommends a systematic arrangement of outer yards for car transfer movements. But my Chicago talk called particular attention to the fact that the proposal for leaving the St. Louis railroads alone in the individual operation of their local freight terminals was the backbone of our entire report and distinguished it from the reports on the Chicago situation by the Chicago Railway Terminal Commission and the Board of Economics and Engineering of the Association of Security Holders, in both of which reports complete unit operation was recommended. This is explained in the following quotation from the paper which I presented in abstract at the Chicago meeting:

"It is interesting to note that the Board of Economics and Engineering, appointed by the National Association of Security Owners, after a study of the Chicago situation, recommended practically the same kind of a group yard plan of classification and interchange of carload freight. The Board went farther, however, and recommended the complete unification under single control of the entire Chicago terminal. The St. Louis committee does not believe this to be practicable. The latter terminal might be unified if all the railroads possessed equal advantages in location and facilities, but unfortunately that is far from the case."

The words "unification" and "unit operation" have been surrounded by a sort of halo or glamor by those who have advocated the principle, and large sections of the public have come to believe that such operation offers the only remedy of terminal delays. That is not the case, and a great deal of false effort will be wasted along such lines until there is a clear conception of the difference between the consolidation of certain features of railroad terminal operation, such as the classification and transfer of interchange freight, which is most desirable, and the unit operation or unification of terminals, which may not be at all desirable, at least in some instances.

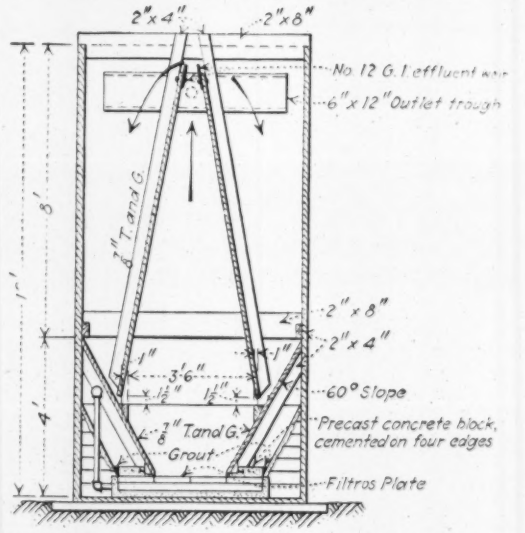
C. E. SMITH,
Consulting Engineer.

St. Louis, Mo., July 27, 1923.

[The paper by Mr. Smith pointed out that "unification of freight handling at St. Louis is in sight." Evidently there is need for a recognized definition of or distinction between the terms unification and unit operation, which at present are used indiscriminately by different writers.—EDITOR.]

Activated-Sludge Tank Under Test at Argo, Sanitary District of Chicago

Sir—In your issue of June 28, p. 1136, Prof. Harold A. Thomas outlines a variation of the activated-sludge tank, which resembles very much a type of tank which has been experimented with by the Sanitary District of Chicago and the Corn Products Refining Co. at Argo during the past year. I attach herewith a cross-section of the tank which



CROSS-SECTION OF ACTIVATED-SLUDGE TANK AT CORN PRODUCTS TESTING STATION, ARGO, ILL.

was suggested in 1920 by Dr. Mohlman to produce circulation, using the general features outlined by Professor Thomas. This tank was installed in the summer of 1921. During the past twelve months this tank has constantly produced a good effluent with 75 per cent of the amount of air used by the ridge-and-furrow system similar to the Milwaukee plant, operated in parallel. However, the eccentric type of plate placing, similar to that used at Manchester, England, and proposed for Indianapolis and the North Side sewage-works of the Sanitary District of Chicago, has been producing a good effluent with even less air. While this peculiarly baffled tank is an interesting one from a standpoint of study, its construction on a large scale would be somewhat expensive and very much more so than the type proposed at Indianapolis and in Chicago.

Our experiments at the present time are directed along the line of finding what the minimum amount of air is that can be used where the agitation is supplied by mechanical means, and further whether activated sludge can be made by mechanical devices alone, without blowing air. We have not yet obtained results sufficient to justify any statements, but believe that the line of investigation will be helpful in defining future lines of research.

LANGDON PEARSE,
Sanitary Engineer, the Sanitary District of Chicago.

Chicago, July 17.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

Expenditure of Over $11,000,000 on the New York, Chicago & St. Louis R.R. and allied lines, including the Hocking Valley and the Lake Erie & Western, is announced by the president of the N. Y., C. & St. L. $6,000,000 will be spent on improvements to the system and $5,000,000 on equipment.

Further Improvement of Alligator and the Four-Mile Creeks to facilitate large traffic in the coastal area near Georgetown, N. C., is asked by a delegation which appeared before the Board of Engineers for River and Harbor Work of the Corps of Engineers. The Board has recommended that a survey of this area be made to determine the cost of such work.

An Early Test of the Constitutionality of the Act of 1921, which requires the licensing of civil engineers and surveyors in Pennsylvania, is forecast by George D. Stevenson of Scranton. Mr Stevenson stated that the action would be based on the decision against the Act by Judge Samuel Shull of the Monroe County Court. Governor Pinchot vetoed the bill repealing the act.

The Five-Span Wooden Bridge crossing the Delaware River between Stockton, N. J., and Centre Bridge, Pa., was destroyed by fire July 22. The bridge was a covered one and was erected 82 years ago. It was the only structure of its kind between Trenton and Easton, Pa., a distance of more than 50 miles, to withstand the great freshet of 1893. It is probable that the bridge will not be rebuilt.

A Supercable Between New York and Rome, with capacity of 50,000,000 words a year on a line 4,500 miles long by way of the Azores, will be built jointly by the Western Union Telegraph Co. and the Italian Submarine Cables Co. under a contract signed last week by the two companies. This will be the longest and highest capacity cable across the Atlantic and the direct line to Rome will save hours of time over indirect transmission via England and France.

River Gravel for Track Ballast is to be used extensively by the St. Louis Southwestern Ry., the state legislature of Arkansas having ratified an agreement giving the railway company a 10-year right for the removal of sand and gravel from the bed of the Ouachita River near Camden, Ark. It is stated that this is first class material and can be applied at less cost than any other ballast obtainable, while the supply is unlimited. A ballasting program has been outlined extending over a period of years, with a view of completely reballasting the main line already ballasted or ballasting where no ballast has yet been applied.

Road Bond Bill Causes Missouri Highway Department Concern

Attorney General Jesse W. Barrett, of Missouri, has been requested to construe the appropriation act passed by the last legislature providing for the issuance of $5,000,000 state road bonds in 1923, $10,000,000 in 1924, and $10,000,000 in 1925.

The legislature so worded the act to read that $10,000,000 be issued in bonds in 1924 and 1925. Worded in this manner the act might be construed to mean that only $10,000,000 could be issued during both years, while members of the State Highway Commission intended that $10,000,000 be issued each year.

To Build Two New Subways in New York City

The Board of Estimate and Apportionment of New York City, at its meeting on Aug. 3, approved the routes of the proposed Washington Heights and Brooklyn Crosstown subways. The Washington Heights subway will be from 162nd St. on St. Nicholas Ave. to 124th St., to Manhattan Ave., to 110th St., to Central Park West, and south to 59th St. where it will be connected with one of the existing subways. The Brooklyn Crosstown subway will extend from Newtown Creek in Greenpoint generally along Manhattan Ave., Roebling St., and Bedford Ave. to Halsey St., Brooklyn. The connections for this subway have not yet been decided upon. The estimated cost of the two subways is $54,250,000.

General Goethals to Report on Intracoastal Canals

In view of the favorable action upon the report of Col. G. M. Hoffman, district engineer at New Orleans, regarding the proposed inland waterway from the Mississippi River at New Orleans to Corpus Christi, Tex., the Intercoastal Canal Association of Louisiana and Texas has retained the services of Gen. George W. Goethals to investigate the commercial possibilities of this canal. General Goethals will make an exhaustive study of the commercial aspects of such a canal, not only as a local transportation facility in Texas but with special reference to its relation to the inland waterways of the Mississippi valley. The Intercoastal Canal Association is desirous to have this canal so constructed that it will accommodate the same class of traffic as is now using the Mississippi and Ohio Rivers. For this purpose the canal should have a depth of 9 ft. and a bottom width of 100 ft. Such a canal would mean that barges on these two rivers could be operated along the coast of Texas and Louisiana and eventually to the Mexican border.

The Corps of Engineers has ordered that a survey be made to determine the cost of such a canal between New Orleans and Corpus Christi.

Harding's Death To Affect Coal Situation

To Undertake Mediation In Present Situation Means Employment of Sympathetic Understanding

Washington Correspondence

The President cannot die without affecting all industries and most individuals. The death of Mr. Harding comes at the worst possible time in so far as it affects the coal situation. It is certain to have a very direct bearing on the questions of labor relations which are now in such an acute stage.

While those who are in a position best to appraise the situation are convinced that there will be no strike, they must admit that the situation is one in which a crisis might develop at any time. Government intervention is more likely now than ever before in peace time, due to the fact that the public is not inclined, after the experiences of the last few years, to be kept in suspense as to its fuel supply.

Diplomacy Required

Enough has been learned in the last few years of Government intervention to make it very clear that it is a diplomatic rather than an executive undertaking. To undertake to mediate in such a situation as exists today in the anthracite region means the employment of diplomacy such as is implied by the better sense of the word,— the use of sympathy and understanding. Such a task can be undertaken only by a person in whom each side has confidence. Whatever may be said about Mr. Harding's greatness as an executive, no single individual in the land will dispute that he was a man of friendship—a man with an intense desire to do the right thing. He commanded the respect of capital and labor alike because they knew he was big-hearted and would do his best to be fair. On the other hand, the public would have been satisfied with his mediation. People generally do not have an opportunity to go into the details of issues. They would have been willing to abide by his conclusions. The man so amply suited to undertake mediation has been removed suddenly. It is true that the country is to be spared the aimless drifting which marked the administration's policy just before and during the strike of 1919. At that time there was great uncertainty as to the extent of President Wilson's incapacity. No one was sure whether or not the pronouncements coming from the White House were those of the President or of someone else. Later it was established that some of these pronouncements, at least, did not come from the President himself.

In the present situation, the uncertainty is of a different character. There naturally will be delay before the new helmsman will feel confident to take the ship of state into the main channel. The situation is complicated by lack

of knowledge as to what the new President may do. The outstanding achievement of his career is his handling of a labor matter. His action at Boston in connection with the strike of policemen brought him into national prominence and secured for him the praise and support of those who believe a firm stand must be made against the exactions of labor unions. That act, however, antagonized labor. It is certain the United Mine Workers would hesitate a long time before they would agree to accept President Coolidge as final arbiter of questions which to them seem vital. Unquestionably labor unions are not at all sure, but that one of the principal opponents of their policies has been elevated to the presidency. They must recognize that since Mr. Coolidge first came to national notice because of his stand against unionism, it would be only natural were he to be of the opinion that the public approves of such a policy. His experience in Boston may have convinced him that unionism must be curbed and that nothing can be gained by temporizing with it. In such a case he might conclude that the anthracite situation offers a splendid opportunity to put his views into effect.

On the other hand, many think Mr. Coolidge will take this opportunity to demonstrate that he is not opposed to labor unions when properly conducted. He may admit the right of the United Mine Workers to demand all that they have and to strike if they do not get what they ask. At best, however, it is admitted on all sides that the prospect of agreement is less auspicious today than it was yesterday.

A Critical Time

Many doubt that the check-off is the real objective of the United Mine Workers. The rank and file of that organization is so much more interested in wage than in any of the collateral issues, that it is not probable that the necessary support will be forthcoming to insist upon the check-off. The check-off means a great deal to those who are responsible for the financing of the international union but it means much less to the member of a local. The heads of labor unions are like political leaders or the heads of European states in that they can go only so far in persuading their people to accept solutions which are distasteful to them.

Signs are multiplying that the anthracite workers are ready to insist on the increase. Apparently the more conservative leaders, like the heads of the international union, will have great difficulty in avoding a suspension unless they can promise a wage increase. During the last strike it was claimed at first that the anthracite workers were being held out to win for the bituminous workers, and that if they were left to themselves they would return to work. Exactly the reverse proved to be the case. It was nearly a month after the Cleveland agreement before work was resumed, and even then the terms of settlement were all but rejected when the ratification convention met in Wilkes-Barre. Steam roller tactics had to be employed to get ratification through and even then it carried by a small margin. New factors have entered since then to bolster up the determination of anthracite workers. They elected Capellini. They not only elected him but they did it by a large majority. For a time after his election, Capellini seemed to have joined hands with the conservative leaders but now that he has been accepted as a member of the negotiating committee, he has come out with a statement that he will not surrender any demand and that he will press each one of them. With the death of the President and with unmistakeable signs of increased determination on the part of the mine workers, the prevalent opinion in Washington is that the situation has taken on new seriousness.

Woman Succeeds as Highway Contractor in California

When her husband died three years ago and left a $175,000 road building contract to be finished Mrs. Ellen E. O'Brien of Martinez, Calif., decided that the business reputation which her husband had built up should not be impaired. So she undertook the completion of the contract. The job on which Mrs. O'Brien entered the field of highway contracting was the Franklin Canyon Highway, a 9-mile concrete road which she finished in August, 1921. Since that time she has undertaken numerous other contracts and completed them successfully, putting into her work genuine enthusiasm and love for the job. Contracts which she has completed in the past three years include the Marsh Creek highway, a short railroad for the Henry Cowell Lime & Cement Co., a 3-mile concrete road in Napa County, and the 4-mile Moraga Boulevard in Contra Costa County. This latter job was a $95,000 contract, and Mrs. O'Brien finished it thirty days ahead of schedule despite unusual difficulties met in prosecuting the work.

Mrs. O'Brien is an enthusiastic supporter of the Associated General Contractors of America, having attended its latest annual convention held in Los Angeles.

North Carolina Lets Contracts for 136 Miles of Road

The North Carolina State Highway Commission on June 27 let contracts on 21 highway projects totaling 136.23 miles. The total cost of the work, exclusive of the usual ten per cent for engineering and contingencies, is $2,567,254.

Of this 43.31 miles are of standard concrete or asphaltic paving, 16 and 18 ft. wide. The average cost per mile, including grading, draining, structures, paving, and all other construction items, is $34,953. There are 3.07 miles of penetration macadam, which costs, with the same construction items as above, $23,334 per mile. The remainder of the work consists of 89.85 miles of earth, top-soil, and one-course gravel roads, which cost $10,632 per mile, including clearing, draining, grading, surfacing, structures and all other construction items. The structures (reinforced-concrete bridges and culverts) included in the above figures cost $481,868, an average of $3,537 for each mile of road to be built.

Iowa Board of Engineering Examiners Organized

The Iowa State Board of Engineering Examiners has been organized with the following membership: Seth Dean, chairman, Glenwood; L. M. Martin, vice-chairman, Atlantic; Alvin LeVan, Des Moines; B. F. Fleming, Iowa City; and C. S. Nickals, Ames. All correspondence or business matters for the board should be addressed to W. C. Merckins, secretary, State House, Des Moines, Iowa.

Province Has No Jurisdiction Over Railway Bridge

In a decision rendered by the Supreme Court of New Brunswick on the suit by the provincial government to compel the Canadian Pacific Railway to raise the height of its bridge over Reversible Falls, St. John, it has been held that the province has no jurisdiction over the bridge. This decision was rendered after hearings occupying more than a year, in which alleged obstruction to shipping and the danger to the bridge in raising it to a higher elevation were points of contention.

City Planning Division, Am. Soc. C. E., Elects

At the organization meeting of the City Planning Technical Division of the American Society of Civil Engineers, at Chicago, on July 12, a temporary executive committee was chosen as follows: Chairman, N. P. Lewis, New York City; secretary-treasurer, Charles B. Ball, Chicago; together with Harland Bartholomew, of St. Louis, Mo., and E. A. Fisher, Rochester, N. Y. It was decided that it would not be practicable to provide the city planning program for the Richmond meeting of the society in October.

Opposition to Amendment of Transportation Act

Arguments against early amendment of the Transportation Act, as now proposed tentatively and particularly as to providing for compulsory consolidation of the railways, are being issued by the Railway Business Association. It is pointed out that permissive consolidations, as provided for by the Act, have not yet been tried and that the Interstate Commerce Commission is at work on an official plan to which mergers must conform. A sudden change to a compulsory requirement would undo much of the progress already made, it is believed. Furthermore, such a step would produce complicated litigation, or as the Association's letter says, "would guarantee not consolidations but lawsuits."

Conditions prevailing since the passage of the Act in 1920 have prevented any test of rate making, but under present rates a record-breaking business has been handled, railway credit is rising and a great program of improvement work has been undertaken. The Association urges further trial of the present Act without amendment, and suggests that the whole matter should be the subject of competent inquiry by a joint congressional committee to report to the next session of Congress.

Oregon Engineers Urge Congress Probe Ousting of Davis

Protesting against the recent dismissal of A. P. Davis, former director of the Reclamation Service and his replacement by C. W. Davis, not an engineer, the Oregon Technical Council, which is composed of delegates from local sections of the American Society of Civil Engineers, American Society of Mechanical Engineers, American Institute of Electrical Engineers, American Institute of Architects, National Electric Light Association, and the American Institute of Mining and Metallurgical Engineers, has sent a letter to its congressmen urging that Congress investigate reasons for Mr. Davis' dismissal. The Oregon Technical Council also calls attention to the fact that it believes "the civil service law was evaded since the abolishment of the office of director and the substitution therefor of that of commissioner, with identical duties and responsibilities, is a mere subterfuge which should not make it possible to do indirectly what the law forbids to be done directly."

"This is one of the cases," continues the Oregon engineer's letter, "where the enforcement of the civil service law would have been most beneficial to government service, and it is a phase which we believe deserves the closest scrutiny."

The Oregon engineers stand behind Mr. Davis both for his "ability and efficiency as a business man and as an engineer." The Oregon engineer's letter further states that allegations made that Mr. Davis is not a business man and that his office involved a duplication of work "appear to us so manifestly unfounded as to amount to mere excuses. The excellent showing made by the Reclamation Service, the loyalty and faithfulness of its employees, and the confidence of the people and the Congress in the Service, demonstrate clearly both the business and the engineering ability of the former director."

J. C. Stevens is president of the Oregon Technical Council and F. H. Murphy is secretary.

Street Widening Proposed in Philadelphia

A project for the widening of Ninth St. in downtown Philadelphia from Vine St. to South St., has been approved by the Board of Surveyors, and submitted to City Council in the form of an ordinance. The proposed widening is by taking 15 feet off each side of the street, increasing its width from 50 to 80 feet. The assessed valuation of the property required is $3,100,000. It is proposed that the widening shall be extended over a period of years so that the cost for condemnation shall be kept a minimum. The ordinance now before Council places the 80 feet width on the city plan, and all future building will be on the new line.

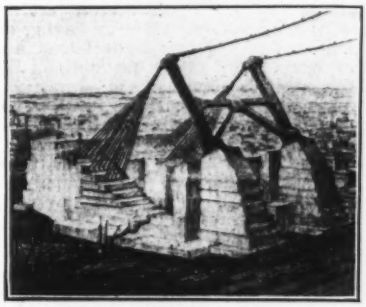
The Board of Surveyors some time ago approved plans for the widening of Vine St., 7th St., Pine St. and 20th St., to form a traffic circuit around the central business section. The proposed widening of Ninth St. is not a substitute for that plan, but an addition to it, affording an intermediate wide street. The ordinance for widening the other streets to form the traffic circuit has been in the hands of City Council for about six months.

To Measure the Water Diverted from Niagara River

The Canadian Government has agreed to the plan proposed by the United States for the measurement of the diversion from the Niagara River. The measurements are to be made under the supervision of a board to be composed of two members, one to be appointed by the Canadian Government and the other by the United States. The American member of the board undoubtedly will be Major P. S. Reinike, the District engineer of the War Department at Buffalo. Canada is expected to appoint William Stewart as its member of the board.

Steel Erection Begun on Delaware River Bridge—Philadelphia

The first shipment of steelwork for the main towers of the Delaware River Bridge, consisting of pedestal sections for the north leg of the tower on the Philadelphia side of the river, was received at the site of the work on July 9.



ANCHORAGE CABLE BENT FOR THE DELAWARE RIVER BRIDGE

Sketch showing how it will look at the end of the first stage. The anchorages will later be completed with an outside structure of granite. Anchorage of the cables is effected by a series of eyebar chains, shown diagrammatically in the drawing.

Erection was commenced at once, and is progressing rapidly. Each pedestal consists of eight fabricated sections, and is 5 feet 6 inches in height and 38 feet 8 inches by 26 feet 1 inch in outside dimensions. Fabrication of other portions of the tower steelwork is progressing rapidly in the shops and shipments will be made soon. The two towers are being constructed by the Bethlehem Steel Co., at its shops at Steelton, Pa.

Contract Let for Second Narrows Bridge at Vancouver

Contract was signed on July 26 for the construction of a railroad and highway bridge across the Second Narrows of Burrard Inlet at Vancouver, B. C. This structure, which has been under consideration for more than a decade, will connect the city with North Vancouver by a crossing whose total length will be about 3,000 ft. This will be made up of 685 ft. of steel spans, about 500 ft. of creosoted pile approach and the remainder of earth fill. The steel trusses will include one 300-ft. span, a 185-ft. single leaf bascule and a 150-ft. approach span. Shorter spans will also be required for crossing Lynn Creek. The structure will be at low level, clearing high tide by about 12 ft. There is a 90-ft. depth of water where the central piers will be sunk. The design will be for a single track railroad with Cooper's E-50 loading and a vehicular roadway cantilevered on either side.

Contract for the work is held by the Northern Construction Co. working in conjunction with J. W. Stewart. The total cost will be slightly over one million dollars, for most of which bonds will be taken by the contractors. The costs are being divided as follows: North Shore municipalities, $630,000; Vancouver, $200,000; Dominion of Canada, $100,000; Province of British Columbia, $100,000. Construction is to be started in the month of August, and it is estimated that two summer seasons will be required to complete the work.

Agree on Joint Board to Inspect Transit Facilities

In connection with the proposed inspection of the structures and equipment of the New York subways and elevated lines for which engineers of the Westinghouse Electric and Manufacturing Company and the General Electric Company and Dr. George F. Swain have already been engaged, the State Transit Commission and the City Transit Bureau have come to an agreement whereby a joint board will be constituted to proceed with this survey. The Transit Commission will be represented by Robert Ridgway and George Gibbs, the Board of Estimate by Dr. George F. Swain, and the Interborough Rapid Transit Co., by George H. Pegram, and the Brooklyn-Manhattan Transit Co. by Eugene Klapp and W. G. Gove.

PLACING THE PEDESTAL SECTIONS OF DELAWARE RIVER BRIDGE

Random Lines

Don't They Need No Bananas?

In Circular No. 1546. The Panama Canal asks contractors for proposals to furnish:

"Sheet Iron or Steel, Brass Tubing, Sheet Copper, Sheet Brass, Bronze, Wire Nails, Brass Valves, Sheet Zinc, Liquid Door Checks, Night Latches, Copper Tacks, Hinges, Carbolic Acid, Burnt Sienna, Putty, Mercuric Oxide, Metallic Zinc, Caustic Soda, Soda Ash, Powdered Milk, Turpentine Substitute, Rubbing Varnish, Poultry Netting, Wire Lath, Copper Insect Screen, Sledge-Hammer Handles, Grindstones, Scrub Brushes, Corn Brooms, Emery Cloth, Mattress Ticking, Tennis Nets, Shower-Bath Curtains, Linen Twine, Cotton Batting, Steam Packing, Onion-Skin Paper, Manila Tags, and Beeswax."

* * *

The British House of Lords has just rejected the Tooting Railway Bill. Aren't the noble members getting just a bit oversensitive as to noise.

* * *

And Still They Come

—"J. Kislak, 'The Live Wire,' Hoboken, N. J., *Insurance Engineer* and Real Estate."

—"Have one of our *wrapping engineers* call and show you some of the points he has picked up in his visits to shops and shipping rooms.—The Ad-Tape Co., Inc., of New York.

—"The study of these physical characteristics is the basis of a new profession, which Andre Tridon suggested calling *matrimonial engineers*, and whose business will be to diagnose the chances of happiness two human beings may have who plan to associate their destinies."—Chicago *Tribune*.

—"Ernest E. Lee Co., *Merchant Engineers*, Chicago, Ill."

* * *

What particular blasphemous or irreligious thing have the Chicago engineers been doing that would lead the Chamber of Commerce there to say that Heinie Van Loon is rewriting the Bible "for all kinds of plain people—chambermaid, waiter, postman, engineer, all sorts—who fight shy of the Bible because it is the Bible, but who like a good story as well as anybody else"?

* * *

Mental Hazard

"Governors Favor More Jersey Links," headlines the New York *Times*. Good news for metropolitan golfers, we thought until we read the subhead "Smith and Silzer Urge Additional Bridges or Tunnels as Soon as Possible."

* * *

Highway sign in small town in Ohio near Cincinnati—

"Drive slow—see our town;
Drive fast—see our jail."

Test Section of Automatic Train-Control Works Successfully

An automatic train-control system has been put in operation on the 50-mile branch of the Pennsylvania R.R. between Lewistown and Sunbury, Pa., and the twelve locomotives which constitute the equipment of this line have been equipped with the necessary apparatus, so that all passengers and freight trains are now subject to this control. For this system a track circuit operates cab signals and an air-brake connection on the locomotive. In the cab are three electric lamps. When lamp A is alight the engine man knows he has a clear track for at least two block sections, but if he should try to exceed the maximum speed allowed on the division the air brakes will be applied automatically. When lamp B is alight it indicates one clear section and the mechanism holds down the velocity of the train to an assigned "medium speed" limit.

The third lamp is a "slow" or "stop" signal as conditions may require, and its indication is given about 1,800 ft. before the train reaches a section occupied by another train or having an open switch. If this light burns and the engineman takes no action, the train control devices will apply the brakes and stop the train. But if the engineman acknowledges the signal by throwing a lever, he can proceed at an assigned "slow speed" with his train under perfect control. Any attempt to exceed this speed will result in application of the brakes. The Lewistown branch is chiefly single track, with automatic visual signals at intervals. On half the length of the line these signals operate in connection with the train-control system, but on the other half the dispatcher controls them.

C. & O. Ry. Betterments $14,800,000

The improvement program of the Chesapeake & Ohio Ry. for 1923 includes little in the way of extension but is based on the more intensive development of its existing lines with a view to handling maximum tonnage at minimum cost, as stated by W. J. Harahan, president of the company. The estimated cost of work authorized and under way, but exclusive of new equipment, aggregates $14,815,000, of which $12,777,000 is for road and the remainder for equipment improvement.

Freight yards and passing tracks will total $8,322,517, including $3,630,000 for a new yard at Clifton Forge, Va.; $380,000 for storage yard at Newport News, $285,750 for yard additions at Hinton and Silver Grove, and $4,025,767 for various yard work and for building and extending passing tracks and other side tracks. Next to this big item comes $1,586,266 for shops and engine terminals, shop machinery and coal and water stations. Grade reduction at Paynes, near Covington, Va., will cost $468,000 to reduce grades of 0.4 per cent eastbound and 1.13 per cent westbound to level track. Additional main tracks will cost $446,900, including ten miles of third track between Big Sandy Junction and Russell, Ky. Other items include $116,633 for track realignment at Hinton and Beckley, $500,752 for bridges, trestles and culverts, $424,738 for stations and office buildings, $368,764 for signals and interlocking plants.

Second Incinerator for St. Louis

Bids for the second of a proposed series of five garbage incinerators, with a capacity of consuming 100 tons of garbage in 24 hours, will be received by the Department of Public Utilities, St. Louis, Mo., on Aug. 28. The first incinerator has been in operation for about seven months with successful results and without any complaint from the public.

New Orleans Planning and Zoning Commission Appointed

A city planning and zoning commission of twenty members has been appointed by the Commission Council of New Orleans, under an ordinance adopted May 1 of this year. Of the twenty members, seven are appointed at large and thirteen represent various organizations. J. Frank Coleman, consulting engineer of the New Orleans Dock Board, and one of the members at large is a member of the executive committee of the Commission. Among the organization representatives on the Commission are: the Louisiana Engineering Society, J. W. Billingsley; Louisiana Chapter, American Institute of Architects, Allison Owen; New Orleans Contractors & Dealers Exchange, Richard McCarthy.

The planning commission is given wide authority to study all phases of city planning, including the laying-out of undeveloped real estate. It is also authorized to prepare plans for zoning the city into residential, commercial and industrial purposes. The powers of the planning commission extend to all territory three miles beyond the city limits. No recommendation of the commission has legal effect until accepted by an ordinance of the Commission Council.

Besides money appropriated for the use of the planning commission by the City Council the planning commission is authorized to receive contributions of money or materials to be expended at its discretion but subject to the audit of the Commission Council.

Passaic Valley Outfall Sewer Tunnel Contract Rescinded

Formal notice that it vacated its contract for the construction of the outfall sewer tunnel into New York Harbor was presented July 26 to the Passaic Valley Sewerage Commission by the contractor, the Holbrook, Cabot & Rollins Corporation of New York City. The action is based on refusal of claims made by the contractor for extra cost resulting from alleged misrepresentation by the commission at the time the bids were secured as to the character of the ground through which the tunnel passes. A total of $794,668 of damages is claimed by the contractor. Any payment is refused by the commission which also denies that it misrepresented the conditions in any way. Pending permanent arrangements the commission, by agreement with the contractors, is continuing construction with the contractor's plant and workmen. Twice previously this tunnel has been the object of trouble between the commission and its contractors. The original contract was let to John F. O'Rourke who abandoned the work and filed suit for damages as related in *Engineering News-Record* June 3, 1917, p. 268, and July 25, 1918, p. 191. The second contractor was Charles A. Haskins of Boston who abandoned his contract.

Engineering Societies

Calendar

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Convention, Burlington, Vt., Sept. 18-21, 1923.

INTERNATIONAL ASSOCIATION OF STREET SANITATION OFFICIALS, Chicago, Ill.; Annual Conference, Chicago, Sept. 27-28, 1923.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York; Annual Meeting, Boston, Oct. 8-11.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Fall Meeting, Richmond, Va., Oct. 17-20.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Atlanta, Ga.; Nov. 12 to 16.

The Colorado Engineers Council gave a banquet in honor of R. H. Keays, chief engineer of the Moffat Tunnel Commission, on July 31 at Denver, Colo. W. F. R. Mills of the Denver Union Water Co. presided, and L. G. Carpenter, president of the Colorado Engineers, spoke on "The Engineer and His Position to the Community."

Personal Notes

CHARLES T. BRAGG has opened offices in the General Motors Bldg., Detroit, under the firm name of Bragg Engineering Co., for consulting service in chemical, civil, mechanical and electrical engineering. Mr. Bragg's professional record includes being president of the Detroit Board of Water Commissioners, director of the American Institute of Metals, technical director for Berry Brothers, chemical engineer for the Ohio Brass Co. and works manager for the Michigan Smelting & Refining Co. Associated with the company as consulting engineer is COL. T. A. LEISEN, who was the engineer in charge of construction of Camp Custer, past president of the American Water Works Association and former general manager of the Detroit Department of Water Supplies. Recently Col. Leisen has been designer and engineer in charge of construction of the new Detroit filtration plant, which was described in *Engineering News-Record*, May 17, p. 860.

FRED J. MILLER, Center Bridge, Pa., has been appointed engineer member of the Water and Power Resources Board of Pennsylvania, a new board created by the administration reorganization code in the Pennsylvania Department of Forests and Waters to take the place of the Water Supply Commission of the state.

MAJ. GEORGE H. NORTON, city engineer of Buffalo, N. Y., for the past 14 years, has been appointed chief engineer of the consolidated Terminal and Grade Crossing Commissions of Buffalo. Mr. Norton is a graduate of Cornell University. In his service in Buffalo he directed the Buffalo River improvement, the Scajaquada Creek storm water drain and harbor improvements. COL. CHARLES E. P. BABCOCK, formerly first assistant engineer of Buffalo, becomes city engineer, succeeding Maj. Norton.

W. C. BROWN, a former city engineer of East San Diego, Calif., has completed a course at Leland Stanford Jr. University and has gone to Sonora, Mexico, on an irrigation project.

PROF. CHARLES DAVID MARX, emeritus professor of civil engineering at Leland Stanford, Jr., University, has received an honorary degree from the Technical University at Karlsruhe, Baden, Germany.

BURGIS G. COY, civil engineer of Fort Collins, Colo., has been appointed resident engineer of the eastern portal of the Moffat Tunnel. Mr. Coy is a graduate of Rensselaer Polytechnic Institute, and after some time spent on tunnel work in New York State he went to Colorado where he was engaged on construction of the Laramie-Poudre tunnel; his paper on this tunnel won the Thomas Fitch Rowland award of the American Society of Civil Engineers.

MAJ. E. L. DALEY of the U. S. Corps of Engineers has been appointed engineer officer in Pittsburgh, Pa., succeeding Maj. J. Franklin Bell who some weeks ago was transferred to Washington as engineer commissioner for District of Columbia. Maj. Daley has for several months been doing Red Cross work in Greece and Russia and prior to his work abroad was an instructor at West Point.

ROBERT LLOYD, borough manager for the Borough of Edgeworth for the past three and one-half years, has accepted the position as manager of the Midland Improvement Co. and the Midland Water Co. at Midland, Pa., both subsidiaries of the Crucible Steel Company of America.

H. B. NOWLIN, civil engineer, has accepted a position with the George T. Wilhelm Co., construction engineers of Cedar Rapids, Iowa. Mr. Nowlin has specialized in engineering management and construction machinery. He is now located with the above firm at Elaine, Ark., where they are just completing a 61-mile concrete road.

HON. J. R. COOKE, M. P. P. for North Hastings, Ontario, has been appointed a member of the Ontario Hydro-Electric Commission, and J. G. Ramsden has been removed from membership of the Commission, which is being reorganized by the Provincial Government.

E. W. OLIVER, general superintendent of the Niagara, St. Catherine's & Toronto Ry., has been appointed manager of that road and of the Toronto Suburban Ry. and the Toronto Eastern Ry., and is now superintending the completion of the last named railway.

F. C. PALMER has been appointed town engineer and street commissioner of Bowmanville, Ontario. Mr. Palmer had been for many years engaged in municipal engineering work at Oshawa, Ontario.

GEORGE W. BORDEN, state highway engineer of Nevada, was elected secretary of the Western Association of State Highway Officials at the session held July 10 and 11 at Salt Lake City, Utah.

WILLIAM J. P. SIMPSON announces the opening of offices at 4447 White Bldg., Seattle, Wash., for the practice of civil and industrial engineering. Mr. Simpson had for the past three years been associated with the Continental Pipe Manufacturing Co.

I. KELLERT, formerly assistant town-engineer of St. Lambert, Province of Quebec, has been appointed town-engineer to replace E. Drinkwater, who has resigned.

W. BOYD JONES has opened offices in the Sunderland Bldg., Omaha, Neb., under the firm name of the American Construction Co. and will do a general construction business.

FREDERICK A. DALE, formerly with George F. Hardy, consulting engineer, New York, has become principal assistant engineer with L. F. Harza, consulting engineer, Chicago, whose principal work at present is on the design of the 270-ft. rock fill dam on the Dix River, Kentucky, for the Kentucky Hydro-Electric Co., a subsidiary of the Middle West Utilities Co.

Obituary

WALTER L. KEISER, traveling representative for the Pittsburgh Meter Co., Pittsburgh, Pa., died at his home in Waco, Tex., May 26, after a brief illness. Mr. Keiser was foreman of the company's water meter shops for a number of years before entering the sales field.

CHARLES D. BLANEY, of Saratoga, Calif., chairman of the original California state highway commission and long active in the good roads movement in the state, died July 25. Mr. Blaney was born in Chicago and graduated from Princeton University. In 1882 he moved from Chicago to California. As member and chairman of the state highway commission, he had a great deal to do with the laying out and construction of the highway system under the first bond issue of $18,000,000.

CHARLES J. CONNELL, president and founder of one of the oldest contracting firms in Chicago, the Fitzsimons Dredge & Dock Co., died in Evanston, Ill., Aug. 2, at the age of 84. In 1872 he gave up a position as bank cashier and formed a partnership with Mr. Fitzsimons, their first contract being the Dearborn St. bridge, the first in Chicago to be operated by steam. Since that time the firm has constructed 80 per cent of the bridges (or of their substructures) in Chicago, well over fifty in number. The California St. bridge is now under construction and work was started Aug. 5 on the Adams St. bridge. In 1875 the 12-ft. Fullerton Ave. tunnel, one of the largest water tunnels in Chicago, was driven by this company from the lake to the river. Other waterworks structures were the Carter Harrison, Four-mile and Wilson Ave. cribs, and several more tunnels.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Conference Discusses Standards for Tilting Mixers

At a second concrete mixer conference arranged by the Associated General Contractors of America and held in Chicago July 30 and 31, the main subject was the standardization of tilting mixers. This supplemented the previous meeting on standards for non-tilting mixers, as reported in *Engineering News-Record* of July 5, p. 36 and 19, p. 120. In addition, there was considerable discussion as to changes in the requirements for standardization of mixers in general.

For the tilting mixers one of the main points of discussion was the selection of sizes, which had been proposed tentatively as No. 3, No. 4 (or 5) and No. 7. The outcome was that the meeting did not adopt, but "recommended for adoption," Nos. 3½, 5 and 7. The manufacturer is to state the least angle at which the drum mixes its rated batch efficiently and the capacity of the drum is to be taken as its water level content at this angle. A schedule of the standardization requirements for tilting mixers will be issued shortly, and in many respects will be similar to that for non-tilting mixers, given in *Engineering News-Record* of July 19, p. 120.

In regard to mixers in general, a table was submitted giving the quantities of mixed concrete for the various proportions of mix and giving also the size of batch of various proportions for each standard size of mixer. It was decided that this table should be copyrighted. A schedule of charges for the Association's nameplates on standard mixers was also submitted.

To insure adherence to the adopted standard sizes it was proposed that all non-standard sizes should be eliminated by January, 1925, and that manufacturers continuing to make such non-standard mixers should forfeit the right to use the "standard" name plates for their entire line of mixers. This restriction will not apply to mixers above No. 28 and below No. 3½, which are the limits of the standard sizes.

Newaygo Co. To Build Cement Plant in Wisconsin

A million-barrel (annual) cement plant is to be built in Manitowoc, Wis., by the Newaygo Portland Cement Co. duplicating the recently enlarged capacity of the plant at Newaygo, Mich. Limestone will be shipped across Lake Michigan to Manitowoc from the company's quarries in the Calcite and Petoskey district of Michigan. The new plant is to be located near the site of the Manitowoc Shipbuilding Corp., the steel handling facilities of which will be used to expedite the construction of the cement works.

The Wisconsin plant is to be built and operated by a subsidiary, the Manitowoc Portland Cement Co. With the construction of the new plant new interests from the west side of the Lake enter the company, including the Manitowoc Securities Co. and the Manitowoc Ship Building Corp. Wellborn & Huntington, consulting engineers, Chicago, made the investigation and report on the marketing facilities available at Manitowoc as well as the supply of raw materials.

Program Outlined for Caterpillar Service School

For users of caterpillar tractors the Holt Manufacturing Co. announces that a service school at Wausau, Wis., will open Aug. 13 and continue one week under the supervision of H. H. Chambers, director of the company's service division. The object of the school is to acquaint tractor users with proper methods of operation and maintenance of their equipment. A carload of specially cut-away motors, transmissions, and other assemblies will be used to illustrate, disassemble, and reassemble. Cut-away models of carburetors, magnetos, air cleaners, and other parts will enable the students to learn about operation and adjustment. The company states that there will be no tuition or registration fee charged for the school.

Census Figures Show Scope of American Industry

The Department of Commerce announces that a summarization of the reports made to the Bureau of the Census by the manufacturing establishments in the United States shows that the value of their products aggregated $43,653,283,000 in 1921, as compared with $62,041,795,000 in 1919 a decrease of 30 per cent. Compared with the value of products reported for 1914 there was an increase of 80 per cent due largely to the rise in prices.

A better index of conditions will be found in the figures relating to persons engaged in manufacturing. The average number of wage earners employed in 1921 was 6,946,564, or 23 per cent less than the number reported for 1919, while there is very little difference between the figures shown for 1914 and 1921.

The census statistics for 1921 relate only to establishments having products valued at $5,000 or more.

SUMMARY OF MANUFACTURING PLANTS FOR THE UNITED STATES: 1921, 1919, AND 1914

	1921[1]	1919[2]	1914[2]
Number of establishments	196,267	214,383	177,109
Persons engaged	8,257,376	10,688,849	8,117,895
Proprietors and firm members	172,871	250,571	259,172
Salaried employees	1,137,941	1,438,219	962,533
Wage earners (average number)	6,946,564	9,000,059	6,896,190
Salaries and wages	$10,763,442,000	$13,342,655,000	$5,342,157,000
Salaries	2,563,118,000	2,880,868,000	1,274,438,000
Wages	8,200,324,000	10,461,787,000	4,067,719,000
Paid for contract work	451,580,000	462,994,000	198,720,000
Cost of materials	25,338,617,000	37,288,731,000	14,358,035,000
Value of products	43,653,283,000	62,041,795,000	23,987,860,000
Value added by manufacture[3]	18,314,665,000	24,753,064,000	9,628,925,000

[1] Statistics for 1921 do not include 54,054 establishments employing 40,865 wage earners (average number) with products valued at $136,715,000, each reporting products under $5,000 in value.

[2] Data for establishments with products under $5,000 in value have been eliminated from certain of the items shown, as follows: For 1919—number of establishments, 60,215; wage earners (average number), 41,252; value of products, $151,631,000. For 1914—number of establishments, 95,409; wage earners (average number), 127,495; value of products, $228,654,000. For the other items in the table, separate data for this class of establishments are not available, and deductions cannot be made. Also, data for establishments engaged in automobile repairing in 1919 and 1914 have been omitted from all items shown in the table, as statistics were not collected for establishments of this class for 1921.

[3] Value of products less cost of materials.

Gives Course in the Best Use of Forest Products

Demonstration courses in the best and most economical use of the products of our forests are offered by the Forest Products Laboratory, Madison, Wis.

Details of the several courses offered for personal instruction are given in Miscellaneous Circular No. 8, just issued by the United States Department of Agriculture. These courses are given in the kiln drying of lumber, boxing and crating, gluing of wood, and wood properties and uses. They are arranged to be completed in from one to two weeks and so that a fee of $100 to $150 will be sufficient to cover the cost of the course.

Stress is laid on the practical aspects of the subjects, so that no one need hesitate to enroll because of a lack of technical training. Copies of the circular may be secured from the United States Department of Agriculture, Washington, D. C., as long as the supply lasts.

Road Work Organized in Brazil—Foreign Construction Reported

A number of important public and private works planned or under way in foreign countries have been reported to the Department of Commerce. Road improvement ranks high among these projects.

Plans have been formulated by the Minister of Public Works of the Province of Buenos Aires, which will put highway construction in that province on an organized basis, with funds regularly appropriated for the purpose. Only $370,000 a year will be available at first, but it is planned to levy a land tax to increase this amount.

The city of Sao Paolo, Brazil, has made a contract with a local firm to asphalt 100,000 sq. meters of its streets.

The province of Quebec, Canada, will spend $5,000,000 on roads during the coming summer.

The Brazilian government has awarded a contract to a Brazilian company to construct a naval base in Rio Grande Do Sul with a training school. The total cost is estimated at 8,000,000 milreis. The city of Sao Sebatiao do Paraiso, Brazil, plans to contract for a loan of 1,000,000 milreis for civic improvements.

The Greek government has asked for proposals for the partial construction of the port works planned for the improvement of Piraeus, the port of Athens.

Midwest Terra Cotta Firms Fined

Six terra cotta manufacturing concerns charged with violations of the Sherman anti-trust act, entered pleas of guilty last week before Federal Judge Cliffe, sitting in Chicago, and fines ranging from $1,500 to $3,000 each were imposed. The firms are located in Chicago, St. Louis, Kansas City and Denver.

Business Notes

McWANE CAST IRON PIPE CO., Birmingham, Ala., has opened an office in Dallas, Texas, with J. L. Hill as manager in charge. This office will cover the entire Southwest and Mexico. The firm makes the McWane pre-calked joint and a complete line of cast-iron pipe.

ELK MANUFACTURING CO., of New York City, has been taken over by the Elk Machine Tool Corp., with increased capitalization. The new company will continue to manufacture and sell precision tools under the Elkin patents. The line of tools consists of machine tools for shaving, burnishing and squaring bearings used in internal combustion motors, valve-lifters, air-compressors, Elk terminals and other precision tools. J. G. Elkin, inventor and mechanical engineer, is president of the new company and will have entire charge of the manufacturing and production.

EQUITABLE EQUIPMENT CO., INC., New Orleans, announces the purchase from the Santa Fe R.R. of approximately 16,000 tons of relaying rail varying in size from 50 to 60 lb. per yard

CONTRACTORS EQUIPMENT CO., INC., Detroit, has just completed a large addition to its warehouse and service station for the handling of road and general construction machinery. The location of the new plant is central to the building activities of Detroit.

THOMAS H. DALLETT CO., Philadelphia, manufacturer of pneumatic stone-working machinery and supplies, has purchased a new factory at 165-189 West Clearfield St., Philadelphia, and moved into its larger and more modern plant July 1.

WHITE CO., Cleveland, announces the recent purchase by the City of New York of 100 2-ton motor trucks on a single order. The trucks are equipped with dumping bodies and are for the use of the Department of Street Cleaning. The grand total of White trucks in the city's service is now 551.

KERR TURBINE CO., Wellsville, N. Y., has just undergone a reorganization through the acquisition of practically all its common stock by new interests. Paul B. Hanks, the former president, having disposed of his holdings, has resigned and has been succeeded by W. T. Hamilton of Pittsburgh.

A. J. SWANSON, district manager at Atlanta, Ga., for the North Western Expanded Metal Co., has been transferred to Los Angeles to take charge of the company's Pacific Coast territory.

Equipment and Materials

German Metal-Spraying Process Exhibited at Leipsig Fair

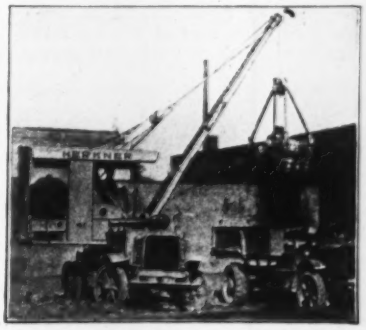
The growth of metal spraying processes in Germany was evidenced by the interest shown in the exhibits of Meurer'sche A. G., of Berlin, at the recent Leipsig Fair, according to reports received by the U. S. Department of Commerce. The devices are claimed to be improvements upon the M. A. Schoop (Swiss) patents of 1909-1911, which covered the process of fusing various metals by means of a hydrogen gas blow pipe or electric current and spraying the molten particles with compressed air. A special company was formed which conducted extensive researches and finally in 1920 N. Meurer obtained about twenty patents which the exhibiting firm now controls. The process is intended to spray aluminum, lead, bronze, iron, copper, brass, nickel, zinc, tin, gold and silver upon the surface of cement, textiles, glass, porcelain, cast-iron, wood, stonework, cardboard, paper, wrought iron, or any other metal articles, covering them with a layer of 1/40 mm. or thicker if desired.

The apparatus is made in the shape of a hand pistol or a tumbler drum with one or more spraying pistols in action. A wire of the required metal is automatically fed through a nipple at one end and as it approaches the other end it is melted by a current of oxyhydrogen gas under high pressure or oxyacetylene gas and the atomized particles are forced out in a jet through a nozzle. The hand pistol is guided in whatever direction work must be done. The jet does not scorch paper or any other inflammable material. It is claimed that the sprayed surface will readily lend itself to polishing and buffing. The primary object of the process is to weatherproof or otherwise protect surfaces subject to oxidation or corrosion.

Truck-Mounted Crane Kept Busy on Variety of Jobs

How one contractor kept a truck-mounted crane busy on a variety of jobs is illustrated by the case of the Peter Herkner Motor Trucking Co., Cleveland. The equipment consisted of a full-circle swing crane, with separate 40-hp. gasoline engines, manufactured by the Universal Crane Company, Elyria, Ohio, and mounted on a used 5-ton motor truck. The outfit handled a ½-yd. clamshell bucket with teeth.

One of the first contracts on which the crane was used was the removal of a 100-yd. ramp in a large building



excavation which had been left in order to get the steam shovels out. The crane, located at the end of the excavation, dug out the material with the clamshell bucket and loaded it into trucks.

Two cellar excavation jobs each involving 300 cu.yd. of excavation, followed. The mobility of the crane reduced to a minimum the time lost in getting from one job to another. When this work was finished the crane was sent to a gravel pit for loading trucks. While this work was in progress there occurred a garbage strike in Cleveland and the truck-mounted crane was drafted for the emergency work of unloading garbage from cars to pit or trucks.

Instead of laying this crane up for the winter, the owner arranged with

Steam Shovel Clears Snow-Blocked Road

With the aid of a steam shovel the six-mile road from Narada Falls to Paradise Valley in Mt. Ranier National Park, Washington, blocked by snow 7 ft. deep, was opened up to traffic this spring a number of weeks earlier than usual. The equipment, illustrated above, consisted of a ¾-yd. Osgood shovel of the revolving type mounted on crawler traction. Similar use of a steam shovel for handling snow was noted in this journal June 7, p. 1022, for clearing the Snoqualmie Pass through the Cascade Mountains in Washington.

the city to handle coal for schools, thus demonstrating the all-year-round service of this equipment. Various odd jobs also were found in and around industrial plants in handling scrap iron to and from cars, pig iron. With the aid of a special bucket an attempt will be made to use it on snow-removal work.

Illuminated Traffic Control Unit

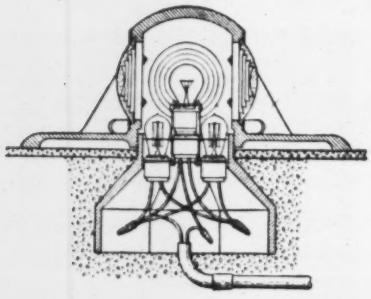
For the control of motor vehicle traffic at street intersections, the Line Material Co., South Milwaukee, Wis., has developed an illuminated unit known as the "Traficon," consisting of a steel casting in the form of a hood extending 8½ in. above the street surface. At each side of the hood facing the intersecting streets a bullseye lens

is set in a recess perpendicular to the pavement. On either side of the lens, as shown in the accompanying illustration, a heavy flange protects the glass from injury and its recessed position in the hood is such as to reduce to a minimum the possibility of damage by vehicle wheels.

To serve its purpose most effectively, the manufacturer states, the traffic marker should be lighted by day as well as by night. To this end the inside of the casting is equipped with two sets of electric lights, one of 25 watts and two of 10 watts each, making possible a minimum charge for lighting during the day.

The casting has a base diameter of 22 in., weighs 115 lb., and requires no bolts to hold it in place. It is painted in bright yellow weatherproof paint. The lenses may be adapted to any color code.

These illuminated traffic guides are



made in two types. One the "directing" unit is merely a marker for street intersections. The other, or "regulating" unit, carries a panel in which the word "Stop" is made to appear and disappear either automatically or under manual control.

New Gasoline Hammer Drill

A gasoline impact drill of the air hammer type which is self-contained, portable and operated by one man, has recently been developed by the Pennsylvania Gasoline Drill Co., Philadelphia.

The drill, which is named the Somervell, weighs only 70 lb. and although developed originally for drilling rock, is applicable to such work as cutting asphalt pavements, ramming backfill in trenches, breaking concrete, driving spikes and drilling holes in masonry.

The mechanical principle of the gasoline hammer drill, as explained by its manufacturer, combines the action of an air hammer and a gasoline engine in such a manner that the drilling unit has but two working parts, the hammer piston and the fly-wheel assembly. No crankshaft or connecting rod is employed and there is no spring or other yielding member used in the internal construction. No inlet or exhaust valve or cam shafts are used, as the air and gas passages are fixed ports, cut through the solid steel of the cylinder. The drill delivers about 1,800 blows a minute; the fly-wheel which returns the hammer piston on the upward or compression stroke.

Since the drill is a self-contained power unit it is not limited in the radius of its action by the length of an air hose or an electric cable. These drills are already being used by the Philadelphia Electric Co., the Western Union Telegraph Co., and the Edison Electric Illuminating Co., of Boston.

Publications from the Construction Industry

Cranes—INDUSTRIAL WORKS, Bay City, Mich., has published a handsome 161-p. book illustrated with reproductions of photographs and drawings in color on the general subject of cranes. The volume, commemorating the fiftieth anniversary of the company has an introduction in the form of a history of the development of cranes dating back to the primitive methods used by the Egyptians in the construction of the pyramids. The text dealing with the modern machinery manufactured by the company is divided into six sections, dealing with locomotive cranes, locomotive crane accessories including buckets, grapples, magnets, and draglines, wrecking cranes, special railway equipment in the form of electric and hand-operated tiller and transfer cranes, pile drivers and cranes constructed for export in accordance with special requirements. The text is fully illustrated and an index aids in finding information on any specific type of crane or accessory. There is an interesting series of photographs of railroad wrecks showing the uses of cranes in rescue and repair work. The application of locomotive cranes to a wide variety of industrial and construction uses also is featured. For the user of cranes the volume contains a wealth of information presented in an attractive form.

Rail Steel Reinforcement—FRANKLIN STEEL WORKS, Franklin, Pa., as a member of the Reinforcing Bar Division of the Rail Steel Products Association, is in a position to distribute the booklet "Rail Steel for Concrete Reinforcing," in addition to those companies listed in the notice of this publication appearing on p. 604 of the March 29 issue of this journal.

Concrete Reinforcement—DAVID W. MORROW, Cleveland, Ohio, describes in a 15-p. illustrated pamphlet his patented three-way system of reinforced-concrete flat-slab construction. The system, in comparison with other types of flat-slab design, it is claimed, results in better distribution of panel area which produces a minimum bending moment and secures a shorter length of steel and an equalization of stresses that could not otherwise be obtained.

Excavator and Loader—T. L. SMITH Co., Milwaukee in a 20-p. catalog, describes and illustrates its excavator and loader with particular reference to basement, bank excavating and loading of sand and gravel, stock piles, stripping, and grading of streets and alleys. The loader is a portable gasoline-driven dragline excavator, designed to fill the gap between the large power shovel and the gang of hand-shovel laborers.

Steel Windows—TRUSCON STEEL CO., Detroit, has issued a folio of "Drafting Room Standards" in loose-leaf form showing typical installation details of steel windows of all types. The information is given on 8 x 10½-in. sheets with drawings to scale. These sheets are accompanied by others carrying specifications for all types of windows shown in the drawings. In offering this portfolio of drawings and specifications the company has endeavored to answer in graphic form every question an architect or an engineer might ask about steel windows and industrial steel doors. Details from the loose-leaf sheets may be traced for incorporation on building plans.

Steam Shovel Costs—ERIE STEAM SHOVEL CO., Erie, Pa., has presented in at 71-p. booklet, illustrated, the results of the prize contest it conducted recently to secure data on the performance and upkeep cost of its shovels. The records cover only those shovels which have handled at least 200,000 cu.yd. of material. On this basis the figures cover 48 shovels. The data are segregated according to the kind of material handled—earth, rock, clay, sand and gravel. Particularly interesting is the general summary giving total upkeep figures and averages for all of the 48 shovels included in the survey.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Production and Materials Stocks in Eight Cities

Midsummer Slow-Down in Iron, Steel and Cement Output—Lumber Above Normal—Fewer Burned Brick Than Year Ago

Iron and Steel—Pig-iron production during July averaged somewhat over 118,000 gross tons per day as against 122,000, during the preceding month. This rate represents a falling off of nearly 5 per cent from the May average, which was the heaviest recorded in the history of the industry. The July output, however, was slightly heavier than that for April; 2 per cent under the June average and 52 per cent greater than a year ago.

There has been some accumulation of pig-iron and steel ingot reserve stocks. Sheet mill operations continue at almost 75 per cent of capacity with finishing mills going at a slightly higher rate.

Lumber—Production is proceeding at a rate nearly 7½ per cent above normal, or at about the same rate as prevailed one month ago. Shipments represent 95 per cent and orders 85 per cent of normal production. While there has been no perceptible falling off in output, shipments have been fewer and orders a trifle heavier than a month ago, despite the general downward trend in lumber prices. One year ago, production was 6 per cent below normal, shipments, 90 per cent and orders, 87½ per cent of normal production. The following table shows lumber movements during the four weeks ending July 21, compared with the preceding four weeks.

	Four Weeks Ending July 21 Ft. B. M.	Four Weeks Ending June 23 Ft. B. M.
Cut	1,013,633,602	1,101,749,298
Shipments	902,519,673	1,003,405,099
Orders	778,785,990	810,722,740

Cement—Reserve stocks, throughout the entire country July 1, amounted to 9,219,000 bbl. as against 10,718,000, for the corresponding period in 1922, according to the Geological Survey. Production totals for the first half of the current year reached 62,320,000 bbl., against 46,918,000, for the same period in 1922. Shipments during the first half of 1923, totaled 62,226,000 bbl., compared with 48,029,000 during the corresponding period last year. Compared with this time last year, the cement situation is one of increased production and shipments with smaller reserve stocks on hand.

Brick—Report of the Common Brick Manufacturers' Association of America, as of July 1, shows production of new brick for the month, at 128,942,000, with shipments totaling 116,761,000. This leaves the quantity of burned and unburned brick on hand at the plants, approximately the same as for the month preceding. Demand fell off 2 per cent in one month. Stocks of burned brick on hand July 1 were 8 per cent under the amount available for the same period in 1922.

San Francisco—Large stocks of road oils, asphalt, cut nails and manila rope. Plenty of sewer pipe, clay drain tile and other clay products. Fairly heavy reserves of track supplies, lime, triangle mesh, steel structurals, black steel sheets and wire nails. Dealers' stocks of metal lath, steel bars, brick, tile, lumber and galvanized steel sheets, in good shape. Stocks low, however, on cement, structural rivets and blue annealed steel sheets.

Los Angeles—Enough sewer pipe to fill requirements. Cement situation easier, owing to improvement in mill shipments. No shortage of lime in this district. Dealers' stocks able to take care of steady lumber demand. Structural steel demand slightly in excess of supply. Supplies sufficient in other building materials.

Minneapolis—Stocks of brick, tile, lime and cement are reported ample, with no trouble in supplying demand promptly. Some shortage of low grade lumber is said to exist, a condition obtaining through much of this season, with the higher grades in good supply.

Detroit—Lime, lumber and sewer pipe stocks normal for season. Small reserves of asphalt and hollow tile. No shortage of cement; mills at high production rate. Plenty of common brick and structural steel.

Cincinnati — Scarcity of cement. Plenty of other construction materials.

New Orleans—No reserve stocks of wood paving blocks kept on hand during the last year. Made up as ordered. Stocks of Southern pine much below normal. Plenty of other building materials.

Atlanta—Plenty of brick and lumber. About seven cars of steel structurals; sixty, of lime and seventy-five each of cement and asphalt, on sidings. Sewer pipe and hollow tile deliveries take from four to five days.

New York—Brick scarcity continues, although volume of new business has been considerably reduced. Brickyards, in districts supplying this market, running at full capacity with heavy orders on books. Small reserves of any building materials kept within the city, owing to limited space. Shortage of finishing lime; plenty of common. Small warehouse stocks of steel.

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

Stocks on hand in approximate figures, example: (Cement, Atlanta, about seventy-five cars); time required for delivery M carload lots from mill of "alongside dock," example: (Lumber, New York, four weeks); and stocks on hand in general terms, example: (Brick, Cincinnati, ample.)

	San Francisco	Los Angeles	Minneapolis	Detroit	Cincinnati	New Orleans	Atlanta	New York
Sewer pipe	Plenty	Enough to fill requirements	Demand met promptly	Stocks normal	Plenty	Abundance	Del. take 4 to 5 days	Small reserve in city
Cement	Stocks low	Situation improved in month	Ample	No shortage; mills active	Scarcity	Dealers' stocks large; demand ebbing	About 75 cars	Stocks in city small; mill del. prompt
Lime	Fairly well supplied	No shortage	Plenty	Supply normal	Sufficient	Plenty	About 60 cars	Shortage of finishing lime; plenty common
Common brick	Stocks in good condition	Supply sufficient	Sufficient	Plenty in local yards	Ample	Enough to fill requirements	Plenty	Scarcity
Hollow tile	Plenty	Requirements being met	Enough	Small reserve; del. take several days	Enough	Ample for "off season"	Del. take 4 to 5 days	Shipments keeping up with demand
Lumber	Heavily stocked	Dealers' stocks heavy	Higher grades in good supply	Yard stocks large	Well stocked	Below normal	Plenty	Del. improved; take 4 weeks from mill
Asphalt	Large native reserves	Well supplied	Ample	Small reserve	Plenty	No market	About 75 cars	Heavy reserves in New Jersey
Structural steel	Bar stocks large; structurals fair; low on rivets	Supply trifle under demand	.....	.....	Slackening in demand; plenty in warehouses	.....	Between 5 and 7 cars	Warehouse stocks not large

Construction Equipment Exported

According to figures given out by the Department of Commerce, the following exports of construction equipment, from the United States, occurred during the month of May: 95 concrete mixers costing $74,530; 747,015 lb. of other construction and road-making equipment, valued at $85,348; 452,991 lb. of construction equipment not classified, valued at $97,190; 50 conveyors of the bucket, chain or belt type, valued at $49,850; 11 steam shovels valued at $133,677; 59,508 lb. of dredging machinery, valued at $11,174; 19 cranes, valued at $77,174; 744 hoists and derricks (except mining), valued at $68,865.

Japan was the biggest importer of concrete mixers, taking 53 valued at $32,145; the provinces of Quebec and Ontario, Canada, came next with 20 mixers, at $14,819. These two Canadian provinces also brought miscellaneous road-making and construction equipment valued at about $61,000, in addition to 5 steam shovels valued at $47,000. Other steam shovel exports included one each to Poland, Cuba, Belgian Kongo, British South Africa and two to Algeria and Tunis. Four cranes costing $24,000 were shipped to Canada and two, valued at $17,000, to Colombia. Japan took about $14,000 worth of hoists and derricks during May.

Bids Wanted On Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 75 to 87, are the following:

Double track steel bridge, Jacksonville, Fla., for Florida East Coast Ry. Co., $1,800,000.

Hotel, Coney Island, N. Y., for Sea Gate Hotel & Bath Corp., New York, $1,000,000.

Hospital, Brooklyn, N. Y., for Bikur-Cholin Hospital, $1,000,000.

Slump in Brick Orders

The slump in building is apparent in the report of the Common Brick Manufacturers Association published Aug. 1 (information as of July 1). Gross orders on books June 1 amounts to 403,691,000 brick as against 395,447,000 July 1. Production of new brick in June was 128,942,000 and shipments were 116,761,000.

The falling off in new business, the report states, is most apparent in some of the centers that have been the busiest during preceding months. In New York, Cleveland, Detroit, Chicago, and even in Southern California districts, manufacturers, while well stocked with old orders and running at full capacity, have reported that the volume of new business has been considerably reduced. The condition is generally viewed by the manufacturers as seasonal and while all admit that is is possible that the last six months of 1923 will not pile up a volume in new construction equal to the first six months, this still will be a banner year.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the the issue of Aug. 2; the next, on Sept. 6.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products:									
Structural shapes, 100 lb.	$3.64	—$4.00	$4.20	$3.40	$3.55	$4.20	$3.60	$4.10	$4.25
Structural rivets, 100 lb.	4.40	—4.75	4.90	3.75	4.25	5.40	5.00	4.75	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.54	—4.00	3.80	3.20	3.45	3.85	+3.65	4.10	4.00
Steel pipe, black, 2½ to 6 in. lap, discount	44%	52%	45%	47%	53-5%	36%	+33.2@42.2%	40%	+47.43
Cast-iron pipe, 6 in. and over, ton.	62.30	—54.00	63.00	60.20	60.50	69.00	62.00	70.00	60.00
Concreting Material:									
Cement without bags, bbl.	2.70@2.80	2.85	2.25	2.20	2.50	2.84	2.63	2.90	2.25
Gravel, ¾ in., cu.yd.	—1.75	1.90	+2.38	2.00	+1.85	1.90	2.15	1.25	1.50
Sand, cu.yd.	1.25	1.24	—1.87	2.00	1.25	1.00	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.00	+2.83	2.00	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	63.00	40.00	52.25	—56.50	-42.50@43.75	-42.75	41.00	—28.00	70.00
Lime, finishing, hydrated, ton.	18.20	—22.50	22.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.50	2.35	1.50	1.50	2.70	2.10	2.80	10.00
Common brick, delivered, 1,000.	24.60@25.70	—12.00	13.10	11.00	17@19	12.00	15.00	13.00	16.50
Hollow building tile, 4x12x12, per block	Not used	— 102	.115	.0724	.0816	.065	. .	.11	.115
Hollow partition tile 4x12x12, per block	.1573	— 102	.115	.....	.....	.065	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	—1.05	1.10	—1.19	—1.14	—1.13	—1.25	—1.19	.86	1.38
Common Labor:									
Common labor, union, hour	.75	.35	.....	.....	.....	.50@.55	.55	.....	.....
Common labor, non-union, hour	....	.30	.30@.50	.82½ — .50@.55		.35@.50	.50	.50@.62½	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93¾c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.78). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $47.43; 6-in., $119.

Changes Since Last Week

The general downward trend in prices, particularly of raw materials, reflects the policy of restricted buying which has characterized the market during the last three months.

Lumber and linseed oil lead the decline for the current week; the former reacting to the decrease in demand, and the latter to changes in the flaxseed market. Yellow pine timbers declined $2 per M. ft. in Chicago; Douglas fir dropped $1 in Seattle and Minneapolis. Denver also reports a severe drop in fir timbers during the last two weeks. Raw linseed oil declined 3c. in New York and Minneapolis; 4c. in San Francisco and 5c. per gal. in Dallas and Denver.

Atlanta reports declines in structural steel, cast-iron pipe, finishing lime, common brick and hollow tile. Dallas reports adjustments in sand and gravel prices and a rise in crushed stone, due to higher labor and freight rates. Minneapolis also quotes an advance in ¾-in. gravel, while New York shows a downward trend. Reinforcing bars and steel pipe went up in San Francisco during week.

The iron and steel situation may be briefly outlined as follows: Pig-iron market stronger in several producing centers; inquiries show improvement. Increased activity in steel plate demand. Tank and car construction, as usual, taking bulk of output. Plates and structurals holding firmly at $2.50 per 100 lb., Pittsburgh. Demand largely for immediate shipments; some makers demanding above $2.50 for quick deliveries. Improvement in general tone of finished steel market.

The General Contractors' Association of New Orleans is still holding out against the carpenters' unions. About 90 per cent of the vacancies have been filled by strike breakers and no wage concessions are expected from the contractors.

Freight rates on all clay products shipped by rail from various points in the Mississippi valley to New Orleans, will be increased from 2 to 5 per cent per 100-lb., effective Aug. 15.